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Errata

Vol. 8, No. 6, (1) Note entitled "A Magnetic Study of the Oxides of Chromium and Manganese", *insert* the following between lines 22 and 23 in column 2 on page 253:—"at 65° after which there is a continuous fall". (2) The article entitled, "Agricultural Marketing in Northern India": Page 277, column 1, *substitute* the word "Linseed" in line 45 by "licensed" and *omit* the words "the failure of" appearing in lines 11 and 12 in column 2 of the same page.

Vol. 8, No. 10, page 470, column 1, last line of the first paragraph: *for* "Kamai Lal Mandal" *read* "Kanai Lal Mandal".

Vol. 8, No. 11, page 512, Note entitled, "Condensation of Chalkones with Flavanones": Column 1, line 4, *for* "Ph.CO.CH = CO.Ph." *read* "Ph.CO.CH = CH.Ph." Column 2, line 1, *for* "Pulverisodium" *read* "Pulverised sodium". Column 2, line 2, *for* "the last two being" *read* "the last two reagents being".

Vol. 8, No. 12, December 1939, page 546:—Note entitled, "On Waring's Problem": Para 1, line 6, *for* "Where $n, x_1 \cdots\cdots x_n$" *read* "Where $k, x_1 \cdots\cdots x_n$". Para 2, lines 3 and 4, *for* "Hera" *read* "Hua". Para 3, line 5, *for* λ, *read* λ_1. Para 3, line 8, *for* "k_{2-}" *read* "k_{-2}".

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Science and Society

IMMEDIATELY after the formation of a "New Division" by the British Association for the Advancement of Science, whose ostensible object is to institute enquiries into the social relations of science, events on a stupendous scale occurred in central Europe whose impact on international affairs was such as to rock the whole fabric of civilization to its very foundation. The ardent supporters of the "New Division" maintained a solid silence which must have earned for science the obligation of politicians for not embarrassing their delicate and difficult negotiations. Manifestly the function of creating public opinion either in favour of or in opposition to the conduct of diplomatic relations has become the prerogative of the lay press and of the members of the parliamentary opposition. From the general attitude of the whole body of scientists during the recent crisis, it is to be inferred that they make a sharp distinction between social affairs and political problems and that while the former might constitute a legitimate sphere for their interventions, the latter had best be avoided. We doubt the existence of such a sharp demarcation between the social and political questions whose paths cross one another and in certain directions become interwoven, and it must be dreadfully pretentious to keep them isolated. We can hardly conceive of any political topic the material of which does not prejudice social interpretation, and what is most obvious is that social progress depends in a large measure upon the political acts and policies of statesmen, while both are sustained by the inventions and discoveries of science. Our inability to determine the future trends of human affairs is mostly due to our lack of faith that the progress of social science must be a solvent of most of the economic maladjustments and because we do not maintain the courage and spirit of adventure, so successfully employed in the realms of science, in the political and administrative fields, we are confronted with widespread social and political disappointments.

We welcome the establishment of a "New Division" as an indication on the part of British scientists of their earnestness to investigate the social institutions and the acts and policies of governments which affect the social conditions of national life. In a leading article published sometime ago,

the editor of *Nature*[1] envisages the evolution of a new type of society in which reason and conviction by an appeal to reason are the indispensable bases for any ordered, successful and permanent social advance. The influence of scientists on the destiny of the world may be friendly and fertilising or may be hostile and destructive according to the use to which their discoveries and inventions are applied. The ultimate question on which the fate of the future trend of civilization will depend is the responsibility which scientists are prepared to accept in controlling and directing their gifts and to disentangle the economic maladjustments which give rise to grave disturbances in the domestic and international relationships. Society has willingly permitted those technical improvements which have promoted its material prosperity without previous planning and without provision against maladjustments and naturally disturbances arising from lack of control and direction, must fall heavily on those classes which are economically backward. Scientists accept the laws of cause and effect in their fields of enquiry and partly because of certain social complexes and partly because of their general unwillingness, they hesitate to apply their objective mode of investigation to the organisation of society. This hesitancy on the part of intellectuals must account in a large measure for their thinking irrationally when they have to deal with society as a whole. The lay mind is puzzled over the gaps existing between the technical advance and the social system, the unequal distribution of economic burden and distress in the midst of abundance. Some of the paradoxes of modern life may be removed by exploring the sociological laws of cause and effect on lines similar to the natural science.

The field for such enquiry is practically unlimited in India, and the need for formation of a department of scientific investigation is necessary and urgent. The social organisation of India has a religious background and the possibility therefore, of influencing its conduct is limited by traditional authorities, which happily are breaking down. The constructive outlook for remodelling the social relations of a population differing in almost every detail of its tissue, has long remained beyond the grasp of public leaders and it never formed an integral part of the programme of national progress. The opportunity for scientists in India for supplying this dreadful deficiency in national planning is mature and attractively inviting. The social forces due to an immobile population with an upward tendency, prevention of its migration, unemployment, poverty and illiteracy are as disruptive in India as in any other part of the empire. The task of converting these forces into constructive channels must involve a deeper insight into human nature, which has to be studied both from the philosophical and scientific standpoints; and especially when life seems to be under a heavy travail, a sympathetic concept of its impulses, thoughts and reactions should be an invaluable guide for recognising its social, economic and political trends. We doubt whether after all even scientists and psychologists have discovered the technique or the weapon which they would willingly place in the hands of legislators for reorganising the state and its people.

It seems to us that the Indian Science Congress which enjoys a high prestige in the country should convene a conference of scientists in India for inaugurating a department with the ostensible object of exploring the possibilities of extending scientific methods to the study of social problems. Science has too long been divorced from society, because of the idea that the province of science is matter, and the human sciences like biology, sociology and economics had not acquired the status and importance of the physical sciences. The consequence has led to a dreadful state of affairs where the physical and the moral are indistinguishably mixed up in the social conditions. It becomes increasingly clear how hopeless it is to disentangle them and

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1 *Nature*, April 30, 1938, **141**, No. 3574.

establish new trends in society whose development has been permitted to grow ever more confused and chaotic. The new age of liberalism which has emerged from that of traditionalism must obviously create dynamic changes in the whole social framework, but the impulse of expansion is restricted to special groups which discovered the inadequacy of the traditional mode of moulding character and mind. The changes have now overtaken the masses without being prepared to profit by their results. This unbalance in the social structure must account for all its ills. Have the scientists any technique or formula for their solution? While the social legislator should possess a clear and far-sighted vision of the kind of society he would bring into being, the social scientist should have knowledge to control and direct its tendencies. Science ought to be able to offer answers to questions which governments might ask for their solution and unless a symbiotic relationship is established between social sciences and statecraft, society must drift perhaps on a down-hill course. The infusion of a scientific temper into governance might remove the fanaticism and arrogance of injudicious zealots, "transforming the blaze of passionate propaganda into a cool grotto where people would humbly investigate economic facts and social conditions—which would render the politician sufficiently uncertain about his own conclusions to respect the honest convictions of those with whom he differs".

If the scientific men in India should realise their responsibilities in the task of recognising society, the Indian Science Congress should step across the frontiers of specialists' studies by arranging at its annual sessions symposia on social, economic and ethical problems investigated by the proposed committee. The Congress is most favourably endowed for bringing to bear upon society the broadening and stimulating effects of science, and its realization that the immediate purpose of science is the ordered progress of society, ought to lead to a revision of the Congress programme of functions so as to bring it into intimate touch with the social thoughts and reactions of the body politic.

Water Pollution Research

By Gilbert J. Fowler, D.SC., F.I.C.

AN important article on this subject appeared in *Current Science* for July 1938, in which it was urged that a Water Pollution Research Board might well be established in India and numerous directions were pointed out in which the activities of such a Board could be exercised. No better example of the characteristic teamwork necessary for the successful carrying through of the kind of investigation which such a Board might be called upon to undertake could be found than in the remarkable Report recently issued by the Water Pollution Research Board of London on the Estuary of the River Mersey. To the academic research worker, who is confined most of his time to the narrow limits of his laboratory and is accustomed to the use of instruments of precision which enable him to exercise fairly complete control over the changes which he is endeavouring to examine, the kind of work involved in an investigation such as is set out in this Report must often be unfamiliar.

The terms of reference to the Research Department were comparatively short and simple, *viz.*, to investigate "the effect of the discharge of crude sewage into the Estuary of the River Mersey on the amount and hardness of the deposit in the Estuary". Sewage from a population of about 1·4 million people is discharged mostly untreated into the Estuary and the possible effect of this discharge on the conservancy of the Estuary has been the cause for many years of controversy among the local interests concerned. The investigation required to obtain a conclusive answer to the terms of reference was, however, of a very varied and far-reaching nature.

The problem was, in fact, to observe the effect of a daily volume of some 1,000 million gallons of fresh water, 30 or 40 million gallons of which are crude sewage, discharged into the Estuary. The conditions of discharge will vary according to the change of tide and are naturally dependent also upon changes in weather conditions

particularly on rainfall. Hundreds, if not thousands, of analyses had to be made from the time when research began in April 1933 to the date of publication of the Report, November 1937. Besides chemical and bio-chemical factors, the physical properties of colloids of different types have to be understood; engineering methods for measuring stream velocities both surface and subsurface were necessary and hydrographic surveys had to be made in order to determine the area and dimensions of the Estuary at different periods. It is clear that no one individual can combine the knowledge necessary to obtain trustworthy results in all these directions and therefore teamwork of the highest order is necessary to correlate all the varied results and draw a true conclusion.

The finding of the Report is that sewage in the concentration in which it is present in the Estuary has no appreciable effect on the composition of the mud and other solid matter deposited in the Estuary. Mud in suspension in the Mersey Estuary and in other relatively unpolluted estuaries which were examined is in the form of flocs or aggregates and not in the form of finely divided particles. In this condition the rate of sedimentation of mud is not affected by sewage in the concentration found in the Mersey Estuary. There is no evidence of any increase during recent years, 1909–35, in the difficulty of dredging in the sea-channels in the Liverpool Bay. A reduction of about 52 million cubic yards between 1906 and 1931 was mainly due not to the deposition of mud but to the deposition of sand in the deeper parts of the Estuary. Finally the definite conclusion is drawn that the crude sewage discharged into the River Mersey has no appreciable effect on the amount and hardness of the deposit in the Estuary.

The staff consisted of a Chief Chemist assisted by four competent members of the same profession, four or five hydrographic surveyors and a Consulting Civil Engineer, besides the permanent officials of the Water Pollution Research Board and the Mersey Docks and Harbour Board. Many data were also supplied by numerous responsible authorities in the Mersey area. In the observations made on a number of estuaries in the various parts of the British Isles valuable advice and assistance were given by the Government authorities concerned.

This Report on the Mersey Estuary will probably rank as one of the most detailed and conclusive of such reports, inviting comparison with the Board's own Report on the Estuary of the River Tees and the monumental enquiry by the Metropolitan Sewerage Commission of New York on the sanitary condition of New York Harbour, embodied in three formidable volumes published respectively in 1910, 1912 and 1914 together with a great mass of subordinate literature.

These earlier Reports laid emphasis on the depletion of dissolved oxygen by the presence of sewage in excessive quantities. In the Mersey Estuary Report the physical characteristics of naturally occurring mud and its reactions with sewage under the conditions present in the Estuary receive detailed attention. These researches will be of great value as models for similar investigations which are likely to be called for, *e.g.*, in the Estuary of the River Irrawadi at Rangoon and the Yangtsze near Shanghai.

In India similar investigations are called for in connection with the disposal of Calcutta sewage and with the general conditions of the rivers of Bengal. Prof. Saha, indeed, chose "The Problem of Indian Rivers" as the subject of his Presidential Address to the National Institute of Sciences of India at the Annual Meeting held during the Silver Jubilee Session of the Indian Science Congress Association. This address formed an introduction to an important symposium on River Physics.

Besides investigations involving such varied issues as are comprised in the Mersey Estuary Report, the Water Pollution Research Board is also concerned with large-scale experimental work, such *e.g.*, as the purification of milk factory effluents. Important laboratory researches are in progress particularly on the physical and bio-chemical phenomena of the activated sludge process, the base exchange process of water softening and the contamination of water by lead.

Should the establishment of a Water Pollution Research Board for India, adumbrated in the July article in *Current Science*, find favour with the Government the problems awaiting its attention are numberless. In India the simplest and most primitive requirements of sanitation have first to be met in contradistinction to England and many European countries where the purity of the rivers in highly populated areas has the first claim to attention. Few Indian cities or towns have, in fact, a complete water

carriage system of sewerage. The provision of an adequate water supply is rightly insisted upon by all modern centres of population. It is however often forgotten that the final disposal of this water after use for domestic or trade purposes necessarily creates further problems, if serious menace to health is not to occur through the creation of swamps or the piling up of filthy sludge deposits in neighbouring streams and *nullahs*. The claims of agriculture for increased fertilizer supply may be met by the proper utilization of the otherwise nuisance producing residues of town or village.

In devising suitable means for dealing economically with these problems a Water Pollution Research Board for India may well play a part in importance equal to or greater than its prototype in England.

It is only fair to add that several Municipal authorities in India have already shown themselves awake to the importance of such preliminary research work. Nagpur some years ago arranged for scientifically controlled large-scale experiments involving considerable expenditure in order to compare the relative efficiencies of several methods of dealing with their sewage. Bombay and Ahmedabad have appointed Specialist Research Chemists and have provided laboratories for preliminary investigations of the disposal of their sewage and trade wastes.

Bhopal, Indore and Mysore have carried out important researches on a large and practical scale in connection with the conversion of "habitation waste" into "compost" suitable for agricultural use. Should a Water Pollution Research Board be established either as a branch of the Imperial Agricultural Research Council or as an independent body, it will have no difficulty in finding ample work to do and its collaboration will be welcomed by all those who are doing their best, often under rather difficult conditions, to deal with the problems with which they are faced.

How to View a Picture

By A. Narasinga Rao
(Annamalai University, Annamalainagar)

A GOOD-SIZED picture is hanging in a vertical plane in front of us. It is required to determine the *proper position* (or positions) at which the eye should be placed so that we may have a *correct view* of the objects represented therein.

Before the question can be answered unambiguously, we have to clarify the concepts described in italics, and state the assumptions under which a solution is sought.

We postulate firstly that the Artist has been so much struck by the beauty of a particular scene that he wants others to share exactly the same experience, and that this constitutes the *raison d' etre* of the picture; secondly, that the picture is drawn according to the laws of perspective and that the colour effects are properly rendered —or that it is a photograph. The observer may be said to have a "correct view" of the picture if his visual impression of the relative positions and dimensions of the objects represented in the picture is identical with that experienced by the artist when he looked at the original landscape. Here we are confronted by the fact that visual geometry is essentially a geometry of directions[1] (since all points in the line of sight are visually identical) and that the visual separation of two points (and hence every estimate of size) is to be measured by the angle subtended at the eye[2] by the two points. It follows therefore that:—

> the "proper position" or positions at which the eye should be placed to look at a picture are just those positions relative to the picture at which the angle subtended by any two points in the picture is equal to the angle subtended at the artist's eye by the corresponding points of the original landscape. ....(1.1)

In the case of a photograph (contact print), the proper position of the eye bears to the photo the same relative position as the lens

[1] A more detailed discussion of the essential features of visual geometry will be found in my paper "Through a Railway Window", *Proc. Ind. Acad. Sci.*, 1938, **7**, No. 2, p. 156.

[2] I am not so heartless as to postulate that all my observers are one-eyed! A single picture can, however, give only a one-eye-view of the universe. To take account of binocular vision the considerations of this paper have to be applied to each of the two pictures (slightly different) corresponding to the two eyes.

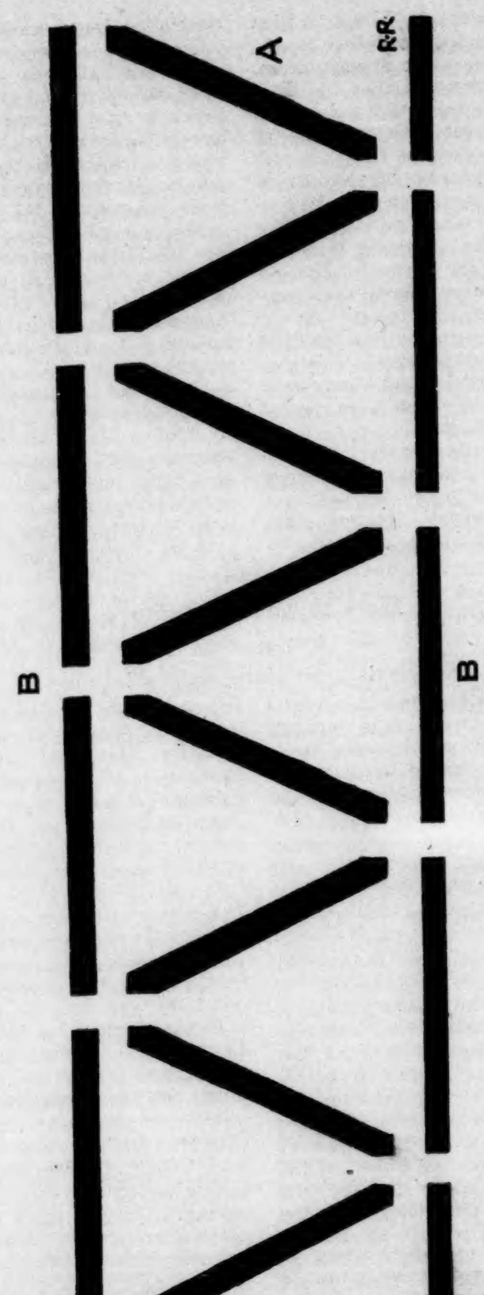

Fig. 1

of the camera to the plate. In the case of a painting, it is the actual position of the eye of the artist relative to the picture; for since it is drawn according to the rules of perspective, the picture may be considered to be the conical projection of the landscape with the eye as vertex of projection.

The questions at issue are:—

(i) Is there only one "proper position"—the one mentioned just now—at which the eye should be placed to get a "correct view"?

(ii) Can such a position be obtained from the data given by the picture itself?

We shall see that the answers to both these questions are in the affirmative.

2. To answer the first query let us assume that there are two possible "proper positions" E_1 and E_2 for the eye of the observer; and let A, B be two points in the picture. By (1.1) the segment AB subtends the same angle at E_1 and E_2, this being the angle subtended at the artist's eye by the two points of the landscape represented by A and B. Hence, if the circle ABE_1 be drawn and rotated about AB, the quartic surface thus generated will pass through E_2. Since this property must hold for every pair of points in the picture, all such surfaces must pass through E_2. It is easily seen, however, that the only common point E_2 is the reflection of E_1 in the plane of the picture. If it is agreed that the observer is to stand in front of the picture and not behind it, there is only one possible position E_1 for the eye which will give a *correct view* of the picture.

Methods for Determining the Proper Position

3. I shall now show that in some cases at least the internal data given by the picture itself will suffice to determine the point E_1, when coupled with our knowledge of what the various patterns represent.

The picture is supposed to be in a vertical plane. The foot of the perpendicular from E_1 on the plane of the picture is called the centre of vision and a horizontal line h drawn through it the "horizon line" corresponding to distant objects at ground level. This line is recognisable in most pictures, but even where it cannot be easily made out, it may be determined if we have in the picture two pairs of lines which are known to represent parallel lines on the ground. Thus suppose we have a quadrilateral pattern ABCD which represents a rectangular object such as a tank, or a tennis court. If the pairs of opposite sides of ABCD meet in P, Q then the horizon line h is PQ. The "proper position" for the eye is in the horizontal plane through h and must be so situated as to project ABCD into a rectangle on any other horizontal plane. Hence the required position lies on the circle described on PQ as diameter. If we have two such patterns which represent rectangles (or one which represents a square) the possible proper positions for the eye of the observer are given as the intersections of two such circles, and will thus be two points E_1 and E_2 which are reflections of each other in the picture plane.

As another example, suppose h has been determined, and also that there is an elliptic pattern Γ in the picture which represents a circular object on the ground or any horizontal plane, such as a circular patch of garden or the mouth of a well. E_1 and E_2 will now be determined as possible vertices which will project h to infinity and Γ into a circle on any horizontal plane. The following construction[3] determines E_1 and E_2:—

Take the pole O of h with respect to the conic Γ and draw two pairs of lines OP, OP′ and OQ, OQ′ through O conjugate relatively to Γ and let them meet h in PP′ and QQ′. Draw two circles on PP′ and QQ′ as diameters in the horizontal plane through h. These will intersect in two points E_1, E_2 which are reflections each of the other in the picture plane. The proper position at which the eye of the observer should be placed is that one which is in front of the picture.

As the main object of this note is to point out the possibility of determining E rather than to give detailed rules for the purpose, I do not elaborate this point further.

A New Optical Paradox

4. Even though the changes in the relative proportions of the parts due to a slight change in the position of the eye often escape attention, it is still of the highest theoretical interest to realise that there is but one position E from which a picture should be viewed so that we may repeat the artist's experience. It is even more startling to find that no other view of the

[3] Filon, *Projective Geometry*, 1935, p. 184.

picture corresponds exactly to the landscape painted by the artist even when the position of the artist is left unspecified; in other words, if the view of the picture from any point F other than E be compared with a painting of the original landscape from every conceivable point of observation—their totality having the same cardinal number as the continuum—not even one of these will agree with the picture.

To prove the last statement, let us assume that the view of the picture from E corresponds exactly to the view of the original scenery from O, and also that the view of the picture from F corresponds to the view of the same scenery from some point P. If A, B, C are three points in the original scenery which are coplanar with O, they are represented in the picture by collinear points a, b, c. Now a, b, c will appear collinear from any other point of observation F, and hence according to our assumption, A, B, C must be coplanar with P. Thus every plane ABC through O passes also through P. This is obviously impossible if P is different from O.

The reason why the changes discussed above do not readily attract attention is that the mind thinks of a picture in terms of patterns, each of which has a specific significance rather than in terms of the proportions of the various parts. It is not difficult, however, to draw a diagram consisting of disconnected lines in which the patterns are not already drawn and presented ready-made to the eye but are left to be formed by the mind. A change in the proportion of the parts may in this case change the pattern itself so that the picture will be subject to a startling change when the position of observation is altered. I give below such a figure (Fig. 1) which, when placed flat on a table and viewed in the direction AA, presents an appearance similar to the pattern[4] in Fig. 2. However, if the same figure be viewed from the direction BB,

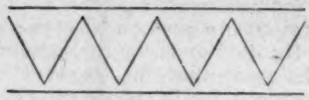

FIG. 2.

the effect of foreshortening is to give it the visual appearance of Fig. 3. To obtain

FIG. 3.

satisfactory results, the eye should be at a convenient distance from the picture at a height only slightly higher than that of the table.

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[4] That when viewed from a distance a set of disconnected lines may look as if they were joined and formed a continuous pattern has been noticed by the Samskrit Poet and Dramatist Kalidasa: Vide *Abhignana Sakuntala*, First Canto, Verse 9.

OBITUARY

Mr. N. G. Majumdar, M.A., F.R.A.S.B. (1897–1938)

We regret to announce the sad and untimely death of Mr. Nani Gopal Majumdar, M.A., Special Officer for Exploration of the Archæological Survey of India, who was murdered under most tragic circumstances on 11th of November 1938, near Johi in the Dadu District of Sind. Mr. Majumdar was deputed from 1st of October 1938 for a period of six months to complete a survey of the prehistoric sites of the Indus Valley Civilization which he had so successfully carried out from 1927–31. Soon after starting work in Upper Manchar Lake area, he was shot dead on the morning of the 11th November by a band of armed dacoits which attacked his camp.

Majumdar was the eldest son of Dr. B. Majumdar of Jessore, and was born on the 1st of December 1897. After a successful scholastic career he passed the B.A. Examination with Honours in Sanskrit in the first division of the Calcutta University and was awarded a Silver Medal and a scholarship. In 1920 he passed the M.A. Examination in Ancient Indian History and Culture in the first division and was awarded a Gold Medal for securing the first rank. His post-graduate studies in the newly organised Ancient History Department of the University were devoted to researches in Sanskrit and Epigraphy, and he derived full benefit from his association with teachers of the calibre of the late Mahamahopadhyaya Haraprasad Shastri, C.I.E., and Professor D. R. Bhandarkar. *En passant* it may be mentioned that it was apparently the

influence of Professor Bhandarkar, the late Mr. R. D. Banerjee and Rai Bahadur Rama Prosad Chanda which was responsible for his developing a keen interest in Indian Archæology. During 1921–23 he was awarded the Griffith Memorial Prize for an interesting thesis on *Vajra*, the Mouat Gold Medal and the Premchand Roychand Scholarship which is the blue ribbon of the Calcutta University awards for a thesis entitled *A List of Kharoshthi Inscriptions.* While carrying on post-graduate studies he was appointed on the staff of the Ancient Indian History and Culture Department of the Calcutta University and continued in this capacity till 1924 when he was selected for the post of Curatorship of the Varendra Research Society, Rajshahi, Bengal. During the period of his curatorship he published a monumental volume entitled "Inscriptions of Bengal," Vol. 3, and as a result of this and other archæological works he was selected in 1925 for archæological training by Sir John Marshall, the then Director-General of Archæology in India. He was later deputed to Mohenjo-Daro where a Chalcolithic culture of the prehistoric times had recently been discovered. After this training he was appointed as Assistant Superintendent for Exploration in the Archæological Survey in June 1927, and the first important work carried out by him was a survey of the centres of the prehistoric civilization of Sind. On the 1st of June 1935 he was appointed Superintendent of the Archæological Section of the Indian Museum. This post he held till the 1st of October 1938 when he was placed on special duty to complete his survey of the prehistoric sites in Sind. In the Indian Museum he re-organized the archæological galleries of the Museum on modern lines, and entirely rearranged the prehistoric gallery. He also published two valuable guides to the collections in the Indian Museum, one dealing with the sculptures of the early schools and the other on the Gandhara sculptures. While stationed at Calcutta, he also carried out excavations at various archæological sites, such as Lauriya-Nandangarh (Champaran Dist.), Kosam (Allahabad Dist.), Durgapur (Burdwan Dist.) and several other sites in Bengal. In addition, he deciphered and edited a large number of *Brahmi* and *Kharoshthi* inscriptions which have thrown considerable light on a number of complicated problems of Indian History.

Mr. N. G. Majumdar, M.A., F.R.A.S.B.

Mr. Majumdar was one of the most distinguished products of the modern school of Archæology in India, and was a very versatile scholar. The published results of his work bear ample testimony to his knowledge and the varied nature of his interests in the different branches of Indian Archæology. He was also a recognised authority on the early history of India, and presided over the History Section of the Prabasi Vanga Sahitya Sammilan held at Patna in December 1937.

Most of his earlier work was published in the *Indian Antiquary* and *Epigraphia Indica*, while his famous memoir "Explorations in Sind" was published in 1934 as Memoir No. 48 of the Archæological Survey of India. He contributed a valuable paper on the Copper Coins from the Stupa area in *Mohenjo-Daro and the Indus Civilization*, and a chapter dealing with the inscriptions of Sanchi is being published in the *Monuments of Sanchi*. In addition, a large number of his papers dealing with *Brahmi*, *Kharoshthi* and later inscriptions have been published in the *Epigraphia Indica*. An interesting contribution of his to the India Society's publication heading *Revealing India's Past* (which is now in the press) deals with prehistoric and protohistoric civilization.

He joined the Royal Asiatic Society of Bengal as an Ordinary Member in June 1920 and was elected a Fellow in February 1936; he was probably the youngest Fellow to enjoy this great honour. He also served on

the Council of the Society for a number of years. By his early death the Society has lost an active member and an outstanding scholar in the very prime of his life. Whatever branch of Archæology he touched he left his mark.

Mr. Mahes Prasad Bajpai (1907–1938)

MR. M. P. BAJPAI, who was Lecturer in Geology in the Department of Ceramics, Benares Hindu University, met with a fatal accident near Lachhman Jhula in the Almora District, United Provinces, on the evening of the 15th November 1938. He was out in field on behalf of the Government of the United Provinces to whom his services were lent by the University and was carrying out prospecting work under the newly planned Mineral Survey of the Province. It seems, while climbing a steep escarpment on way to a gypsum quarry he fell deep down into a gully and died instantaneously due to the fracture of the skull. The entire details of the accident are not known.

Mr. Mahes Prasad Bajpai

Mr. Bajpai was born in 1907 in the Etawah District, United Provinces, and had his Secondary education in the Local High School. In 1924 he joined the Benares Hindu University where he studied Geology and eventually passed the M.Sc. Examination in that subject in 1930. After this, he took to research and investigated a number of problems many of which were of economic importance and aimed at the development of the mineral industry of the country. He carried out mineral prospecting in several States and many districts of the United Provinces, Central Provinces, Bihar and Madras Presidency and discovered a large number of new mineral deposits which included mica, felspars, pottery clays, limestones, talc, glass sands, etc.

In the brief span of six years as a geologist, he published a large number of papers both of academic and economic importance. His work on Gwalior Trap has been of outstanding value and will remain a work of reference for a long time. Much of his work on the Cuddapahas is yet left unpublished. During the last monsoon he, along with a colleague from the Department of Geology, surveyed the flooded districts of the United Provinces and investigated the causes of these floods in this area. He was busy writing the report suggesting measures for preventing the occurrence of these floods which are so frequent in our country and devastating in their nature. Although very young, his researches on clays brought him on the Editorial Board of the *Indian Ceramics*, a newly started quarterly journal.

Mr. Bajpai was a keen sportsman and an excellent field-geologist. Even under the most trying circumstances, he would not hesitate in pursuing arduous work. He felt homely alike in the hot sandy deserts of Cutch, the barren hills of the Salt Range and in the cold hills of the Siwaliks. His enthusiasm and zeal for work was endless. In his premature death at the young age of 31 years, our country has lost a promising geologist.

A. G. J. AND M. L. M.

WE regret to announce the death of Dr. A. S. Menon, D.Sc., Lecturer in Physical Chemistry, Annamalai University, Annamalainagar at the early age of 35.

LETTERS TO THE EDITOR

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Radiating Masses in Einstein's New Relativity

IT is well known that the field equations of general relativity have not yet provided a satisfactory mechanics of radiating masses. Following the ideas of classical relativity it has been shown by the author[1] that even radiating small masses trace geodesics. However, according to the recent developments of general relativity, largely due to Einstein[2] and his collaborators at Princeton, the geodesic-postulate is extraneous and the field equations themselves ought to give both matter and motion. The question now arises as to whether the new theory explains the problems of radiating masses such as (i) the external field of a radiating mass or (ii) the motion of a radiating mass in the field of another. The latter problem is of great astronomical interest in connection with the evolution of binary stars.

It is found that the new exposition of general relativity fails to explain the mechanics of radiating masses. This comes out, moreover, in a way, not anticipated by Einstein and his collaborators. It is not possible to give here all the details but the crux of it is that, in the problem of p bodies, the following equation (1938 2b, §9) is obtained:

$$\underset{3}{\gamma}_{\text{o}n,n} = \underset{2}{\gamma}_{\text{oo},\underset{1}{\sigma}} = \sum_{k=1}^{p}\left(-4\overset{k}{m}\Big/\overset{k}{r}\right)_{,\sigma} \qquad (1)$$

Einstein and his collaborators now remark: "This equation can be solved without introducing new singularities only if $\overset{k}{\dot{m}} = 0$. In other words, the quantities $\overset{k}{m}$, which actually measure the masses of the point singularities, are necessarily constant".

What needs to be pointed out here is that if we use the time-equation of motion for the k^{th} particle (1938 2b, §7) we get from (1) itself

$$0 = \underset{3}{\overset{k}{C}}_{\text{o}} = \frac{1}{4\pi}\int^{k}(\underset{2}{\gamma}_{\text{oo},\underset{1}{\text{o}n}} - 2\underset{3}{\Lambda}_{\text{o}n})\cos(n\cdot N)\,dS = \overset{k}{\dot{m}} \qquad (2)$$

Hence $\overset{k}{m}$ must necessarily be constant, that is, the masses must be necessarily non-radiating, which we get without attempting a solution of (1).

The failure to incorporate non-static masses in the treatment of the new as well as classical relativity must be attributed either to the field equations or to the condition at infinity, *viz.*, that the field is Galilean there. A Galilean field at infinity is necessary for the conservation of energy of any isolated material system;[3] and so, if the joint system consisting of radiating masses and outgoing radiation satisfies the principle of conservation, space-time is expected to be flat or Galilean at infinity.

V. V. NARLIKAR.

Benares Hindu University,
December 8, 1938.

[1] Narlikar, V. V., *Nature*, Oct. 15, 1938, 142, 717.

[2] (*a*) Einstein, and Rosen, *Phys. Rev.*, 1935, 48, 73.
(*b*) Einstein and others, *Ann. of Maths. Zs.*, 1938, 39, 65-100.
(*c*) Infeld, L., *Phys. Rev.*, 1938, 53, 836.

[3] Tolman, *Rel. Thermo. and Cosmo.*, 1934, 228.

Molecular Oscillation Frequency in Viscosity and Raman Effect

Calculations of viscosity on the basis of Andrade's theory have so far been made in the case of monatomic substances, whose frequencies of molecular oscillation are computed from Lindemann's expression. The viscosity η of such a substance at its melting-point is given by the formula:

$$= \frac{4}{3}\ \frac{M}{\sigma} \times 2\cdot 8 \times 10^{12}\sqrt{\frac{T_f}{MV^{2/3}}} \quad \cdots \quad \text{(i)}$$

More generally, for all substances including compounds we will assume that M denotes the molecular weight, V the molecular volume, T_f the melting-point and σ the mean distance between molecular centres. Calculating viscosity values for a number of organic substances from the formula (i), a fair agreement between the observed and the computed values is noticed.

Table I

Substance	η Calculated from (i)	η Observed*	Ratio $\frac{\eta \text{ Obs.}}{\eta \text{ Cal.}}$
Heptane ..	·002472	·00253	1·02
Pentane ..	·002223	·00256	1·15
Octane ..	·00[illegible]648	·00244	0·92
Propyl Chloride ..	·002770	·00352	1·27
Propyl Bromide ..	·003574	·00388	1·08
Propyl Iodide ..	·004058	·00420	1·03
Carbon tetrachloride	·004811	·00654	1·35
Chloroform ..	·004278	·00465	1·08
Benzene ..	·003766	·00391	1·03
Ethyl Benzene ..	·002817	·00282	1·01
Ethyl Sulphide ..	·0027[illegible]5	·00279	1·01
Carbon Bisulphide ·	·003715	·00367	0·99
Propyl Acetate ..	·002895	·00304	1·05
Methyl Formate ..	·003387	·00384	1·13

* Macleod, *Proc. Phys. Soc.*, 1938, **53**, 788.

The mean value of 1·08 for the ratio indicates the general applicability of Lindemann's expression. Further the Lindemann frequency which is generally accepted to coincide with the Debye maximum frequency or the Reststrahlen frequency often gives rise to a Raman line in the scattered radiation from such monatomic substances as diamond, phosphorus, sulphur, etc. Some of the Raman lines observed close to the Rayleigh line by Gross and Vuks[1] as well as Sircar and Gupta[2] in some organic crystals seem to arise from the same source.

Table II

Substance	ν Calc. in $cm.^{-1}$	ν Obs. (Raman Spectra) in $cm.^{-1}$
Diamond	1302	1332
Calcium Fluoride ..	330·6	322
Sodium Chloride ..	195·9	235
p-Dibromobenzene ..	23·32	20·1
p-Dichlorobenzide ..	30·03	27·6
Naphthalene	36	42
Ammonium Chloride ..	171	160
Phosphorus	27·5	36
Sulphur	88	85
Mercurous Chloride ..	316	312
Aragonite	107·3	94

The existence of the Lindemann or the Debye maximum frequency in the scattered spectra favours the view that the Raman lines close to the Rayleigh line arise from lattice oscillations.

L. Sibaiya.
M. Rama Rao.

University of Mysore,
Central College,
Bangalore,
December 19, 1938.

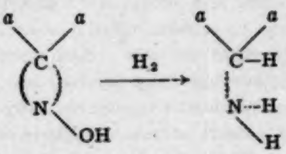
[1] Gross and Vuks, *Nature*, 1935, **135**, 998; *Journal de Phys. et le Radium*, 1936, **7**, 113; and Vuks, *C.R. de l'Acad. des Sc., U.S.S.R.*, 1936, **1**, 72.

[2] Sircar and Gupta, *Ind. Jour. Phys.*, 1938, **12**, 35–46; and 1936, **10**, 473.

The Space Configuration of Nitrogen in the 3-Covalent State

THE configuration of nitrogen compounds of the ammonia (NH_3) or amine (Nabc) type has been an outstanding problem in stereochemistry. There are two alternatives: (*a*) the nitrogen atom lies in one plane with the three attached groups, so that the molecule has a plane of symmetry; (*b*) it does not lie in that plane, in which case the molecule has a spatial configuration.

On the latter hypothesis, compounds of the type Nabc should exist in enantiomorphous forms. This has never been observed. Evidence from physical properties of ammonia or amines, however, clearly supports the view that in these compounds, the nitrogen atom does not lie in one plane with the three attached groups. The object of this note is to furnish an unequivocal answer to this question from stereochemical evidence. The work of Mills[1] on centro-asymmetric oximes and hydrazones has conclusively proved that the doubly linked valencies of nitrogen in the oxime grouping are not coplanar with the singly linked one (I), thus:



(I) (II)

On reduction, an oxime (I) gives the corresponding amine (II). If in the molecule of the oxime, under consideration, the plane containing the doubly linked valencies of nitrogen does not *originally* contain the singly linked valency, carrying the hydroxyl group, the position of the latter linkage will remain unaltered relatively to this plane which now contains two single valencies in the resulting amine (II) in place of the original doubly linked valencies (I). In other words, the three valencies of the nitrogen atom in an amine are not coplanar. Figs. 1 and 2 are photographs of the models of an oxime and the corresponding amine: one of the two large connected spheres (Figs. 1 and 2) represents the carbon atom, and the other, the nitrogen (striped), to which

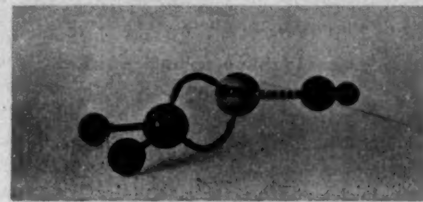


FIG. 1

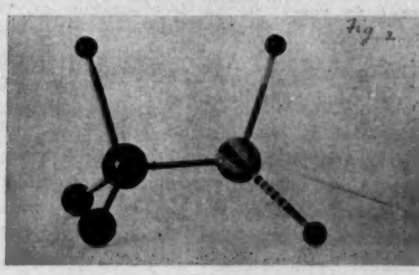


FIG. 2

a smaller sphere representing the oxygen atom is attached; the latter carries a still smaller sphere, representing the hydrogen atom. The striped link, carrying the spheres representing the hydroxyl group, is shown lying outside the plane containing the two links representing the double bond (Fig. 1). It is clearly seen that this link still lies outside the plane, containing the two single links, resulting from the double link, in the corresponding model of the amine (Fig. 2). A fuller account of this work will appear elsewhere.

BAWA KARTAR SINGH.
The Chemical Laboratories,
Science College, Patna,
October 26, 1938.

[1] Mills and Bain, *J. C. S.*, 1910, **97**, 1866; Mills and Saunders, *ibid.*, 1931, 537.

The Endo-Enzyme in Tea Fermentation

THE study of the enzyme system responsible for the 'fermentation' of tea, has been so far conducted on the enzyme extracts using aqueous solvents. Both oxidase and peroxidase

actions have been observed in these extracts,[1,2,3,4] and it is still unknown whether what partakes in the reaction is either one or both of these enzymes.

In addition to these soluble enzymes, however, it has now been found that tea leaf contains an endo-enzyme which is insoluble in the usual aqueous solvents for enzymes. Thus, extraction of the suitably prepared leaf with water, buffer and glycerine solutions still leaves behind an active enzyme, which would also appear to react during fermentation on the polyphenolic substrate.

The presence of this endo-enzyme can be demonstrated as follows:—

The leaf is well ground with sand under acetone and filtered, repeating the operation several times until all the colouring constituents are extracted. The residue, which is almost colourless, is dried in vacuum, thoroughly extracted with solvent buffer solution and washed well. The insoluble leaf tissue thus obtained gives all the reactions familiar to tea fermentation with a tea extract or theotannin isolated according to the method of Shaw.[5]

To indicate the activity of the insoluble enzyme the supernatant liquid is drained off, the residue washed free of colour, and a fresh tea tannin solution added when again the orange red colour is produced.

Sufficient evidence is at hand to show that this enzyme, which is an oxidase in its nature, is different in characteristics from the soluble tea enzyme. Apart from the obvious solubility differences, it would appear to have an optimum pH between 5·0 and 5·5 and withstands concentrations of KCN up to M/50, the usual oxidase or peroxidase being inactivated far below this concentration. Further, the endo-enzyme acts on high concentrations of tea tannin which, it is shown, would inhibit the action of soluble enzymes. The reaction mixture itself with tea tannin has a bright orange red colour identical with the 'tint' of the liquor obtaining when the fermented leaf is infused.

The further nature of this endo-enzyme, the exact mechanism of its action, and the actual role it plays in 'fermentation', are being investigated.

H. B. Sreerangachar.
Biochemical Laboratories,
Tea Research Institute of Ceylon,
December 17, 1938.

[1] Mann, H. H., "The Ferment of the Tea Leaf, Parts I, II and III," *Indian Tea Association, Scientific Department*, 1901, 1903, 1904.
[2] Oparin, *et. al.*, *Biochemical Aspects of Tea Industry, Georgia, U.S.S.R.*, 1935, 107.
[3] Kursanov, *ibid.*, 1935, 125.
[4] Roberts, E. A. H., and Sarma, S. N., *Biochemical Journal*, 1938, **32**, 1819.
[5] Shaw, W. S., *U.P.A.S.I., Bull.* No. 4 (*a*), 1935.

A Note on the Modification of Shellac with Organic Acids

It has been recognised that shellac is mostly composed of hydroxy acids in the form of condensed esters, lactides or lactones. From the constitution of shellac so far understood, it can be said to contain five hydroxyl groups and at least one carboxyl group. The predominance of a large number of hydroxyl groups, free and combined, led to the idea of modifying shellac by esterification with several organic acids and subsequent reduction of residual acidity by combining the esters with mono or polyhydric alcohols. Such combinations might have specially water and heat resistant properties, an expectation fully confirmed by the results of actual experiment.

Shellac was condensed with several organic acids like maleic, phthalic, succinic, adipic, butyric, malic, etc. Later, phosphoric and boric acids were also included in the list, and useful products were obtained. The condensations could be brought about directly or in the presence of solvents and non-solvents of shellac. The alcohols investigated for reducing the final acidity of the condensation products include glycols, glycerine, butyl alcohol, etc. The modifications possess various degrees of hardness, elasticity and adhesion. A typical preparation with maleic acid which (without the final condensation with alcohols) has given promise of an extended use of shellac for special varnishes, is described below.

A 40 per cent. solution of shellac in industrial alcohol (filtered free of wax) and 5 per cent. maleic acid on the weight of shellac are refluxed for 3–4 hours over a water-bath and cooled. Air-dry films of this varnish on glass and metal sheets possess improved adhesion, gloss, elasticity and water resistance.

Films from varnishes treated with maleic acid and control varnish were prepared on copper sheets (0·065 mm. thickness) caked at 120° C. for 18 hours and examined for appearance, adhesion and flexibility. The following are some of the results:—

chemical action of shellac on copper (as evidenced by the absence of greening effect) even on prolonged baking, say 18 hours at 120° C. In general, baking such films for a short time at 100–110° C. confers better mechanical and water-resistant properties without causing pinholes or blisters. As example of practical applications, it has been found that aluminium and tin foils coated with such coloured lacquer do not peal off or show cracks on repeated bending, twisting or folding; electric bulbs dipped in the lacquer stand up to weathering without fading of colour or cracking of the film. Such a varnish could be used also for furniture polish.

TABLE I

	Appearance	Bending test
Control-varnish	Mottled and Greenish	Poor adhesion and flexibility
„ „ heated	„	„
„ „ „ with 0·5% Maleic Acid ..	Smooth film, no green colouration	Good elasticity and adhesion
„ „ „ „ 5·0% „ ..	„	„
„ „ „ „ 10·0% „ ..	„	Poor adhesion and flexibility
„ „ „ „ 20·0% „ ..	„	„
„ „ „ „ 40·0% „ ..	„	„

Uniform films from the same varnishes were next prepared on glass slides and their resistance to water was measured qualitatively. Table II summarises the observations made.

When an alcohol-soluble dye is dissolved in such a varnish, the resulting lacquer has superior colour fastness on exposure to light and heat. Maleic acid treatment also prevents the

It has also been found that varnishes from such modified shellac could be plasticised with 5 per cent. glycol phthalate or castor oil resulting in a further improvement in elasticity without deterioration in properties such as water resistance, etc. If, however, more than

TABLE II

Behaviour of films on glass after immersion in water

	4 hours	24 hours	1 week
Control-varnish	Blush	Blush	Blush
„ „ heated	Slight blush	„	„
„ „ „ with 0·5% Maleic Acid ..	No blush	No blush	No blush
„ „ „ „ 5·0% „ ..	„	„	„
„ „ „ „ 10·0% „ ..	„	Slight blush	Slight blush

5 per cent. castor oil is used, the resulting varnish coated on copper darkens on baking.

It should be mentioned that addition of more than 5 per cent. of maleic acid to the shellac results in poorer adhesion and elasticity in the varnish film.

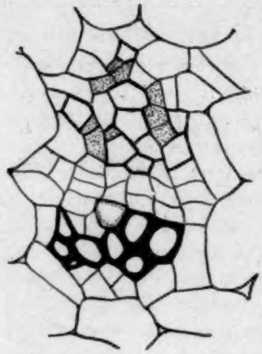
M. VENUGOPALAN.

Indian Lac Research Institute,
Namkum.
May 25, 1938.

Intrafascicular Cambium in a Monocotyledon

RECENTLY, while studying the floral morphology of *Iphigenia indica* Kunth (Fam. Liliaceæ), collected from Krusadai Island, South India, I have come across distinctly active intrafascicular cambium in several parts of the plant. I first observed this in the pedicel, and Figs. 1 and 2 reproduced here are from this organ. Later I observed similar intrafascicular cambium in the vascular bundles of the bracts, young leaves and the nodal regions of young stems. The cambium differentiates along with the primary xylem and primary phlœm (Fig. 1), as in a dicotyledonous bundle, and functions in the same manner, forming secondary xylem to the inside and secondary phlœm to the outside (Fig. 2), but the amount of the two tissues varies somewhat in different bundles. In some cases, the intrafascicular cambium gives rise to almost equal amounts of secondary xylem and second phlœm, as is the case in Fig. 2, but in others it forms more of secondary xylem or phlœm.

1



2

FIGS. 1 and 2. *Iphigenia indica*

Vascular bundles from transverse sections of two pedicels of different ages. Fig. 1, a young bundle showing differentiation of primary xylem, primary phlœm and intrafascicular cambium. Fig. 2, an older bundle, showing the formation of secondary xylem and phlœm. × 700.

The occurrence of intrafascicular cambium in the Liliaceæ has already been recorded in *Hemerocallis*,[2,4] *Allium*,[1,4] *Lilium*,[1] *Dracœna*,[1,6] *Gloriosa*,[9] *Orinthogalum*,[8] *Yucca*,[10] *Milla*,[10] *Dipcadi*,[10] *Galtonia*,[10] *Albuca*,[10,4] *Fritillaria*,[10] *Eremurus*,[2] *Asparagus*,[2] *Nothoscordum*,[2] *Ophiopogon*,[3] *Phormium*,[3,4] *Veratrum*,[3,4] *Anthericum*,[4] *Arthropodium*,[4] *Colchicum*,[4] *Hyacinthus*,[4] *Kniphofia*,[4] *Scilla*,[4] *Smilax*,[3] *Rhipogonum*,[5] *Asphodelus*[5] and some other genera,[7] but there is no previous record of its occurrence in the genus *Iphigenia*.

A. C. JOSHI.

Department of Botany,
Benares Hindu University,
December 12, 1938.

1 Anderson, S., *Bihang till k. Svenska Vet. Akad. Handl.*, 1888, **13**.
2 Arber, A., *Ann. Bot.*, 1917, **31**.
3 Arber, A., *ibid.*, 1918, **32**.
4 Arber, A., *ibid.*, 1919, **33**.
5 Arber, A., *ibid.*, 1922, **36**.
6 Dauphiné, A., *Ann. Sci. Nat. Bot. ser.*, ix, 1917, **20**.
7 Gatin, V. C., *Rev. Gen. de Bot.*, 1920, **32**.
8 Lonay, H., *Mem. Soc., Roy. Sci. Liege, ser*, iii, 1902, **4**.
9 Queva, C., *Trav. et Mem. de l'Univ. de Lille*, 1899, **7**.
10 Sargant, E., *Ann. Bot.*, 1908, **22**.

REVIEWS

The Stuff We're Made of. By Dr. W. O. Kermack and Dr. P. Eggleton. (Edward Arnold & Co., London), 1938. Pp. 342. Price 7s. 6d. net.

"A preposition is a word that you must not end a sentence with", said the professor; but Drs. Kermack and Eggleton, supported by so high an authority as H. W. Fowler, evidently claim that the legitimacy of a prepositional ending in literary English must be uncompromisingly maintained. The excellence of their book entitles them to this dictatorship.

A very successful attempt has been made to delineate in detail the building materials of the body, and the chemical processes by which the body works. It begins with an appeal to the sense of proportion invoked by an ingenious yardstick of the universe in which the unit is the proton. Ascent of the scale by one unit corresponds to multiplying the previous number of protons by 10. Thus at 6 on the scale we have reached 10^6, or one million protons; a red blood-cell stands at 14, a whale at 32, the world at 51·6 and the sun at 57 on the scale. This helpful idea is elaborated in the frontispiece, "From molecule to nebula", comprising six objects, each of which is about one billion times (10^{12}) as large as the next in series.

There follow chapters on the methods of pursuing a scientific inquiry, and the underlying principles of molecular architecture, leading to the nature and sources of energy with special reference to the animal body. On this compact foundation is developed the purpose of the book, namely, to portray the relationship between living and non-living matter, thus proceeding to an admirable account of recent biochemical researches in simple terms illustrated by intelligible formulæ.

From this we learn of the things we must eat, of the vitamins, of the enzymes—"Nature's stepping-stones"—and of the hormones in relation to reproduction and growing-up. A chapter entitled "Chemical Makeshifts in Nature" concludes with an illuminating survey of the skeletal kinship among the sterols, œstradiol, testosterone, calciferol, cholic acid, strophanthidin and methylcholanthrene, one of the most active of the cancer-producing compounds. The chapter called "No-Man's-Land" is an enlightening discourse on the scale-region below 10, embracing bacteria, the viruses and bacteriophages; whilst the conclusion is pleasantly philosophical, showing that the development of general scientific study, of biochemistry and physiology in particular, tends to weaken the vitalistic view-point which claims that living matter displays phenomena basically different from those of inorganic nature.

The authors have contrived a most commendable art of exposition. They use diverting expressions and plain language to convey elusive ideas and complicated changes, thus producing an exceptional book which, at the very modest price of issue, constitutes a genuine mine of information and stimulation.

M. O. F.

Testing Television Sets. By J. H. Reyner. (Chapman & Hall, Ltd., London), 1938. Pp. vii + 128 with 49 figures. Price 9s. 6d. net.

This book on the testing of television receivers by an experienced radio engineer and writer like Mr. J. H. Reyner is an indication of the present status in Great Britain of the development of television as a public service. With advances in the transmission service, there has been a gradual increase in the number of television receivers in public use; and these have to be maintained in satisfactory working condition by efficient servicing.

Mr. Reyner's book is primarily designed for the service engineer who is at home with the basic principles of television transmission and reception. It is not just a bundle of notes but deals intelligently and briefly with the theory and design considerations underlying the troubles that normally arise in practice in a television receiver. Mr. Reyner analyses the causes of defective operation and failure occurring in each of its component parts and describes the methods of locating them and the measures necessary to set them right. In several cases, sample calculations have been worked

out to illustrate the method. A considerable part of the book is necessarily taken up with the cathode-ray tube—both electrostatic and electromagnetic—and its associated apparatus such as the time base and synchronising circuits. The excellent reproductions of the pictures on the screen bring out clearly the different types of distortion described in the text.

A word of praise is due to Mr. Reyner for the many practical hints and advice that he gives as well as for his emphasis on a number of precautions in testing. Amongst these are the damage to the cathode-ray tube screen by a stationary spot (page 25), the discharge of condensers through a resistance (page 23), the precaution against electrical shock by keeping one hand in the pocket when testing with the other (page 21). There are a number of circuit diagrams, the usefulness of which is enhanced by the values of the electrical constants of the component parts. And special mention must be made of the first and last chapters dealing with apparatus and technique necessary for testing television receivers.

Amongst so many good and useful features, there are a few minor defects. For example, what exactly is meant by the opening sentence in Chapter II? Such terms as "h.t. voltage" (page 32, line 20), "bottombending" (page 59), "shorting" (page 64), etc., are rather inappropriate in a book, whatever their justification in conversation. So also the technical jargon in the second para on page 57. One must demur against the statement that the charging current is proportional to the charge (page 55) and the definition of time constant on page 57.

RE

Ions, Electrons and Ionizing Radiations. By J. A. Crowther. (Edward Arnold & Co., London), 1938. Seventh Edition. Pp. 348. Price 12*s*. 6*d*.

Every student of Physics is familiar with this book which has already gone through a number of editions. As the author himself puts it, as a result of the unparalleled outbursts of discovery, experimental and theoretical, of the past twenty years, the book has undergone many changes. Its purpose, however, remains unaltered.

The sections on Cosmic Rays and the chapter on the Nucleus are most interesting and instructive. They have been rewritten and very considerably enlarged. The presentation of the subject is systematic and fully indicates the very rapid advances made in these branches.

The book is one of the best on this subject and as a study-book for the college student, it occupies a particularly very high position.

The conclusions of modern researches are mentioned in the text, without, in most cases, going into their mathematical details. This helps the student to be generally well-acquainted with the most important topics of the day.

A special chapter dealing with atmospheric electrictiy, specially dealing with the recent work on ionosphere and the like would considerably add to the value of the book.

One of the principal features of the book is the balanced treatment of all the different branches of the subject and the systematic plan which maintains the link between them all.

G. R. P.

An Introduction to the Chemistry of Cellulose. By J. T. Marsh and F. C. Wood. (Chapman & Hall, Ltd., London), 1938. Pp. xv + 431. Price 21*s*. net.

Considering the technical importance of cellulose and its derivatives, there are few books on the subject and the present volume is an extremely valuable addition. Written by two members of the research staff of the Tootal Broadhurst Lee Co., Ltd., a firm which has been one of the pioneers in the application of chemistry to the processing of textiles, the book is an authoritative survey of every aspect of the chemistry of cellulose. Almost the only criticism that one might offer is that, in common with several other recent books on chemical technology (particularly of American origin), clarity is sometimes sacrificed in an effort to be comprehensive in the citation of literature. One might also add that in an *Introduction to the Chemistry of Cellulose* experimental details are best omitted, unless these relate to methods which have been accepted as the standard; in a subject such as this, in which the bulk of the work has been very recent and in which a great deal of the published material is of an inconclusive and empirical character, few procedures could claim to have attained the status of standard methods. Although the original literature on cellulose is vast and

complex, the research worker in the field will perforce have to wade into it, so far at least as his immediate problem is concerned, and there is little to gain by attempting to include in a general and introductory survey a detailed account of experimental procedures. Further, in making a choice of methods meriting full description, a slight tendency towards insularity seems difficult to avoid.

A very pleasing feature of the book is the stress laid on the practical applications of cellulose chemistry. The references to patent literature are extensive and every important development in the preparation and utilisation of cellulose derivatives has found a place. For any one desiring to undertake a study of the esters and ethers of cellulose, there could be no better starting point than Part IV of this book.

A few minor omissions may be noted. In dealing with the dispersion of cellulose, no reference is made to a commercially available organic solvent marketed by Röhm and Haas. The expression "degree of mercerisation" is loosely employed; while there are tests for characterising mercerised cotton, of which the baryta number is the most reliable, none has yet been shown to be adequate for a quantitative estimation of the "degree of mercerisation", apart from a photometric assay of the lustre. Edelstein's very useful work on the influence of temperature and other factors in mercerisation has escaped notice. So have Sauter's conclusions on the unit cell of cellulose, preferring the Sponsler lattice to that of Meyer and Mark. Hudson's researches on the graduated fission of carbohydrates by means of periodic acid might have received fuller treatment than the brief reference to "the interesting speculations on the chemistry of oxycellulose formation".

This is a book for every textile chemist and every cotton mill in the country to possess.

K. V.

Life-Histories of North American Birds of Prey (Part 2). By Arthur Cleveland Bent. (*Bulletin 170 of the Smithsonian Institution, United States National Museum, Washington*), 1938. Vol. 8. Pp. viii + 482, 92 plates. Price 60 cents.

This is the eleventh of the series of bulletins on the life-histories of North-American birds, which so far includes Wildfowl, Marsh Birds, Shore Birds and Gallinaceous Birds. The excellent manner in which Mr. Bent has sifted, collated and marshalled the wealth of information at his disposal makes these publications of the highest value to students of birds, not only in America but also throughout the world, particularly to those interested or engaged in conducting research in Economic Ornithology. It was precisely such comprehensive investigations on the life-histories of Indian birds, as a groundwork for more specialised studies, that were contemplated in a scheme for research in Economic Ornithology submitted by the Government of Bombay to the Imperial Council of Agricultural Research about three years ago. After some deliberation, the scheme was turned down by that body, ostensibly for financial reasons, since it was made clear at the outset that the work would, of necessity, have to remain unremunerative in its early stages. It is not heartening to workers to find facilities blocked due to such a short-sighted and commercial view of scientific research not uncommonly taken in this country. The ever-ready—and often convenient—plea of "financial stringency" is an argument which it is always difficult to meet!

The present volume deals with 20 species and subspecies of the Order Falconiformes, all belonging to the Family *Falconidæ*, and 56 species and subspecies of the Order Stringiformes comprising the Families *Tytonidæ* and *Strigidæ*. As full a life-history as possible has been given of the best known subspecies of each species. Duplication is avoided by writing briefly of the others and giving only the characters of the subspecies, the range, and any habits peculiar to it. "Life-history" covers: Courtship, Nesting, Eggs, Nestling, Young, Plumages and Moults, Food, Behaviour, Voice, Enemies, Seasonal Movements, Spring and Autumn Migrations, Range, Breeding Range, Casual Records, etc.

The compilation of such a comprehensive manual—and the others of this series—has naturally only been made possible by the co-operation of a large number of scattered observers. The magnitude of the task will be appreciated when it is realised that receipt of material from close on 400 contributors has been acknowledged. The distribution paragraphs have been compiled from the matchless files of the Bureau of

Biological Survey and are as authentic and up-to-date as it is possible to have them.

The 92 plates accompanying the volume are well-chosen and depict nests, eggs, nesting sites and young of falcons and owls in their various plumage stages. The very full and useful bibliography, covering 22 pages, is another feature for which students will be thankful.

There is a great deal that workers in India will find suggestive in this monumental series of life-histories of American birds. The volumes cannot but serve as an inspiration, and must form a very desirable adjunct to every ornithological library.

SALIM ALI.

Chemical Tables from Handbook of Chemistry and Physics. (Published by the Chemical Rubber Publishing Co., Cleveland, Ohio). Price $3.

The original *Handbook of Chemistry and Physics* published by the same Company, has been a well-known reference book of proved utility to many individual physicists and chemists. The wide range covered by its contents and the very reasonable cost at which the book has been available are its significant features. In its succeeding editions, however, including the last 22nd edition for 1937–38, the book has grown to over 2,000 pages and this has tended to make the handling of this *Handbook* somewhat inconvenient. At the suggestion of several prominent users, the publishers have now separated out the portions immediately useful to the chemists, into a convenient-sized volume of "Chemical Tables", while, at the same time, incorporating some additional features such as Melting point and Boiling point index, tables of Free energies, Ionisation potentials, etc.

This new form of the well-known *Handbook* will, no doubt, be even more welcome to the large circle of chemists. The price of this volume in India is only 3 dollars; and for this price, the fare provided is, indeed, very liberal.

M. A. G. RAU.

Modern Atomic Theory. By J. C. Speakman. (Edward Arnold & Co., London), 1938. Pp. 207. Price 6*s*. net.

In the *Preface* to this book the author says that it has been written with a view to its being useful to science students in universities and colleges and in the upper forms of schools and possibly to the general scientific readers as well. The reviewer has no hesitation in saying that this object has been amply fulfilled. A logical treatment of a subject that is progressing rapidly, is in the nature of things, a difficult process but the author's efforts in this direction have been very successful. Stress has been laid on the physical principles underlying the atomic phenomena and the treatment is non-mathematical. A student desiring to specialise, is enabled to build up the proper perspective necessary for the study of a subject of such fundamental importance. The tables given, make the book useful for ready reference as well. The very clear presentation of the whole subject makes it easy for the general scientific reader to acquaint himself with the nature of atomic processes. The treatment is accurate and agreeably concise. A bibliography of select books has been given in the end for the benefit of those who desire detailed information. The illustrations and the index add to the value of the book.

D. S. R.

The German Primer for Science Students. By H. Biswas. (University of Calcutta), 1938. $9\frac{1}{2}'' \times 6''$. Pp. 258.

While science is international the language in which its results are expressed is not so. This is an unavoidable obstruction which can only be got over by a student of science by learning several languages. It is a known fact that nowadays German is the medium in which the largest quantity of research-output is expressed in any single language. Hence the minimum equipment for a student of science should include a knowledge of German. But the chief modern language which an Indian student learns at school is English. Hence he has usually to pick up German at the post-graduate stage, when he has hardly time or inclination to take a formal course.

The value of Biswas's *German Primer* is best seen in this setting. It is pre-eminently "German self-taught". It has all the merits due to its being based on the concrete experiences of a student of science who had struggled to acquire this language and has achieved full success. It is indeed very good of Biswas to place the benefit of his achievement at the disposal of other students of science.

After developing the essentials of grammar in a human way in the first 59 pages the author has devoted a section to literature and one to each of the important sciences. These sections contain the special vocabulary of the field covered and illustrative passages with English translation. The book ends with about 50 pages of a select vocabulary of words common to all sciences and literature. The illustrative passages chosen are so interesting and are here and there illustrated with Sanskrit parallels in such a dextrous way that one is led on by the thought-content of the passages, incidentally picking up the language with the least conscious effort. This no doubt is the correct way of introducing grammar and I should like to congratulate Mr. Biswas on his success in this difficult art.

The book is rightly dedicated to the memory of Sir Asutosh Mookerjee who has perhaps done more than any other Indian in recent years to put his countrymen abreast of others in matters of scientific research. It is also fitting that the University of Calcutta, which has done pioneering work in the furtherance of research under the inspiration of Sir Asutosh, should have come forward to make this one of its publications and thus extend its services to students of science in all Indian Universities.

S. R. RANGANATHAN.

Manufacture of Soap in India. By A. K. Menon. (*Bulletin of the Indian Industrial Research Bureau*, No. 12. Government of India Press, Simla), 1938. Pp. 63. Price Re. 1.

The Industrial Research Bureau has been publishing a number of bulletins of technical importance to Indian industries. On the subject of Indian Vegetable Oils and allied products, we had an excellent Bulletin (No. 10 of the series, by Mr. N. Brodie, M.SC., F.C.S., A.I.C.) and we were looking forward for the logical outcome of this Bulletin, *viz.*, those dealing with the industries that utilise the oils and fats available in India. Appropriately enough the manufacture of soap in India has claimed the attention of the Bureau owing to the recent remarkable development of the soap industry in India.

Nobody could have been better placed to handle this subject in India than Mr. A. K. Menon, B.A., F.C.S., Superintendent, Kerala Soap Institute, Calicut. Few remember that Mr. A. K. Menon was a student in the famous laboratories of Dr. J. Lewokowitsch, the world renowned authority on oils, fats and waxes. This was nearly twenty-eight years ago. Since his return to India, Mr. Menon has been working continuously in Calicut in the Government Soap Factory belonging to the Government of Madras. Mr. Menon combines very happily the attributes of a research worker, a versatile professor and an able Chemical Engineer, accompanied by business acumen and enterprise. He has contributed several papers on Indian Oils and Fats; he has, since its beginning, been the Principal of the Kerala Soap Institute; and he has made a success of the Kerala Soap Institute from the business point of view. Therefore, any book on Soap-making in India from the pen of Mr. A. K. Menon will have a stamp of authority backed by unique experience.

Purely from the scientific and technical point of view, the Bulletin is a compendium of useful information to Indian Soap-makers. It is to be noted that Mr. Menon was not writing a text-book nor an exhaustive monograph on the subject from a purely scientific point of view. The Bulletin under review contains within a small compass an adequate amount of scientific, technical and business information which an industrialist in India may seek to have authoritatively for guidance before investing his money on it. There is a necessity in India to place before our political leaders, well-written, easily understandable and at the same time, scientifically accurate bulletins to supply them with a background of scientific and technical information that are necessary to guide them in their nation-building activities.

Students of General Chemistry who have no time to wade through either learned text-books or original research papers will get a bird's-eye-view of the Industry in this Bulletin which is neither too specialised nor too pedantic.

The Industrial Reserch Bureau should be congratulated on the production of this excellent Bulletin. S. G. SASTRY.

The Raman Jubilee Volume

THE November issue (Vol. 8, No. 5) of the *Proceedings of the Indian Academy of Sciences* has been published as a Jubilee Volume in commemoration of the Fiftieth Birthday of Sir C. V. Raman, and the completion of ten years of research on the Raman Effect. It is a unique publication being the first of its kind undertaken to honour an Indian Scientist, and is a great tribute to the work of this leader of scientific renaissance in India of the last quarter of a century. As indicated in the *Prefatory note to the special number,* very short notice, in fact a bare three months' time, was given to the several contributors while it is usual to plan at least a year ahead on such occasions. That in spite of this short notice there should have been such a ready and generous response from several men of science of diverse countries, which makes this volume a truly international effort, is ample testimony to the fundamental and comprehensive character of the scientific work of Sir C. V. Raman and his large school of workers.

The Raman Jubilee Volume is limited to original papers on the Raman Effect, light-scattering and related topics, being by far the best-known field of investigations of Sir C. V. Raman. The volume opens with a portrait and a brief life-sketch of the great leader of science in India. The contributions, thirty-eight in all and running over to more than 300 pages, touch upon every aspect of light-scattering and Raman Effect and indicate, as is anticipated by J. H. Hibben in his paper on *A Statistical Analysis of Trends in Research on the Raman Effect,* a wide and sustained interest in the subject in all countries, and an extensive range of problems which come within its scope.

Of the five publications on classical light-scattering, the short and suggestive paper on *Thermal Dependence of Elasticity in Solids* is contributed by Léon Brillouin. Closely related to the latter is the paper by L. Sibaiya on *Scattering of Light in a Rochelle Salt Crystal,* in which he reports the Brillouin components corresponding to the longitudinal Debye waves in this crystal and correlates the observed shifts with its elastic constants. In his paper on *Light-scattering in Anisotropic Media* Hans Mueller develops an extension of his theory of Brillouin scattering of light to optically anisotropic media and obtains remarkable confirmation of his conclusions from Krishnan's data for scattering in graphite sol under the influence of a magnetic field. R. S. Krishnan reverts to the problem of *The Anomalous Depolarisation of Light-scattering in Optical Glasses* and presents quantitative results based on photographic photometry demonstrating the existence of the *Krishnan Effect* in them. V. S. Vrkljan contributes a paper on *"Theoretische Bemerkungen Zum R. S. Krishnan's Reziprozitätsgesetz der Kolloid-Optik".*

Of the 26 papers on the Raman Effect, ten are contributed from the laboratory of K. W. F. Kohlrausch who is in no small measure responsible for the rapid progress of the subject during the past ten years. In the series of publications emerging from his school entitled *"Studien Zum Raman-Effekt",* contributions 89–95 appear in this volume. *"Mitteilung 89: Aethylenoxyd"* by K. W. F. Kohlrausch and A. W. Reitz gives the results of measurements of Raman spectrum of ethylene oxide and its polarisation characters and a detailed critical discussion of the results of various authors for ethylene oxide and cyclopropane. *"Mitteilung 90: Parasubstituiertes Acetophenon"* is by L. Kahovec and J. Wagner. *"Mitteilung 91: Asymmetrisches Phthalyl-Chlorid"* is by L. Kahovec, in which the author investigates the possibilities of attributing a C = O frequency of high value to an asymmetrical form of phthalyl chloride. In *"Mitteilung 92: Das Ramanspektrum des dimeren Ketens",* K. W. F. Kohlrausch and R. Skrabal have investigated the spectra of dimeric ketones corresponding to the diketo-form in cyclobutan-1-3-dion and found that the conclusions of the English authors regarding the existence of the dimeric ketones in monoenolic form are not supported by Raman measurements. Kohlrausch and Sabathy present the results of their investigation on the Raman spectra of *Cyclobutan*-1, 2-*dicarbonsaüren und Abkommlinge* in *Mitteilung 93* and O. Ballaus deals with the spectra of *Tetrolaüre und Ester* in *Mitteilung 94.* From a detailed investigation of the spectra of mononitroparaffins, especially with reference to the doubling of the line 1380, Pendl, Reitz and Sabathy (*Mitteilung 95: Stickstoffkörper XII; Nitrogruppe*)

arrive at a tentative conclusion that the nitro-group probably exists in two different forms in these compounds. Among other papers on organic compounds, S. Mizushima and Y. Morino indicate by the calculation of normal vibrations as well as by the study of isotopic effect on the *Raman Spectra and Molecular Configurations of Solid Ethylene Dihalides* that practically all the molecules in the solid state in these compounds exist in the *trans*-form. In a paper entitled *Sullo Spettro Raman Di Alcuni Idrocarburi Paraffinici* Bonino and Ansidei have studied a large number of hydrocarbons and discussed the results in relation to their chain frequencies. Murti and Seshadri have investigated the influence of solvents on the carbonyl frequency of coumarin in their paper on *Raman Effect and Chemical Constitution, Part I. Coumarin.* A critical review which will stimulate further work on the subject, is given by W. Rogie Angus in his paper on *Raman Spectra of Terpenes.*

There is a group of five interesting articles on inorganic compounds appearing in this volume. Mme. Marié Freymann and Réne Freymann have contributed a paper on *Spectres Raman et Spectres D'Absorption Infrarouge de Composés ou L'Azote est Tetracoordonné* in which they have shown that the NH frequency, like that of OH, becomes smaller and diffuse in solids and concentrated solutions of compounds in which nitrogen is tetra-co-ordinated. In the paper on *Raman Spectra of Volatile Fluorides,* D. M. Yost has calculated the force constants, entropies and heat capacities of the halides of B, P, As, C and Si and shown that the Raman spectra have proved extremely useful in solving many problems in Chemistry. In a study on the *Effet Raman et Structure des Composes AX^5: Pentachlorure de Phosphore et Homologues* Moureu, Magat and Wetroff conclude that these compounds have a pyramidal structure with a trigonal base in the liquid state, and in the solid, they have a structure AX^4+ X^-, in which X^- plays a different role from the four other X^+. P. G. N. Nayar has given a useful *Chart of the Raman Bands of Water in Crystals* of many substances, which will be helpful in understanding the structure of bound water. The remarkable changes depending upon the influence of temperature on the vibrational and lattice Raman lines in sodium nitrate crystals form the subject-matter of a paper on the *Scattering of Light in Sodium Nitrate Crystals* by T. M. K. Nedungadi.

Another aspect of the application of the Raman spectra to the elucidation of the nature of liquid state is undertaken by B. D. Saxena in his paper on the *Depolarisation of Unmodified Light-Scattering in Liquids* and he has shown by careful experiments that contrary to the work of earlier authors, normal liquids like benzene and carbon disulphide show a definite depolarisation of the unmodified scattering. Closely related to the above subject is a paper on the *Low Frequency Raman Lines in Organic Crystals* by C. S. Venkateswaran.

An important line of work which is bound to assume great importance in future investigations is the theoretical interpretation of the Raman lines and their intensities in terms of molecular models. The increasing application of group theory to problems of this nature is brought out in a paper by Bhagavantam on the *Interpretation of Raman Spectra in Crystals: Anhydrite and Gypsum* and in another by Venkatarayudu on *Normal Frequency of the Diamond Lattice.* A different method of approach towards the same problem is adopted by O. Burkard in his paper on *Durchrechnung Einigen Ausgewählter Molekul-Modelle,* in calculating the frequencies, mode of vibration and energy distribution for the plane-vibration of valence oscillations depending on the model constants. Equally profitable is the *Relation between the Force Constant, the Inter-Nuclear Distance, and the Dissociation Energy of a Diatomic Linkage* derived by G. B. B. M. Sutherland, in interpreting the Raman measurements of simple compounds. The use of mechanical models in elucidating the vibrations of molecules is illustrated in a paper on *Eigenschwingungen Mechanischer Molekülmodelle. IV. Der Viererring* by F. Trenkler. The influence of multiple scattering of light on the intensity of the Raman lines is theoretically derived by Kastler in his paper on the *Raman Effect and Multiple Scattering of Light.*

Four papers in the volume bear on problems related to scattering of light and three on supersonics. In their paper on *Directional Variations in the Absorption and the Fluorescence of the Chrysene Molecule,* K. S. Krishnan and P. K. Seshan show

that when the incident light vibrations are along the normal to the molecular plane there is hardly any absorption and that only vibrations in the plane are absorbed. P. Jordan has contributed an interesting article *Über Biologische Wirkungen Ultra-violetter Lichtquanten*, in which he shows that a phenomenon akin to Raman effect is taking place in the interaction of light and matter in biological media. In his theoretical paper on *Some Remarks on Reciprocity*, Max Born presents in a very general form, the difficulties which theoretical physics encounters when dealing with the nature of light and ultimate particles. An attempt to examine the diminution of optical anisotropy of molecules of a liquid due to the influence of neighbouring molecules is made by B. S. Madhava Rao and K. Venkatachala Iyengar in their mathematical paper on *An Inequality Concerning Lattice Sums.* Of the three papers on supersonics, N. S. Nagendra Nath gives a theoretical treatment of the *Diffraction of Light by Supersonic Waves*, in which he points out an extreme case where one can get closed expressions for the intensities of diffraction orders. E. Hiedemann and K. Osterhammel have a paper on *Untersuchung von Schall-amplituden-Feldern Mittels Einer Methode der Isochromaten*, in which a method of colour photography is described for the demonstration and the determination of energy distribution of sound field with white light. In his paper on the *Dispersion of Ultrasonic Velocity in Liquids*, R. Bär reports failure to observe any dispersion of velocities in benzene and water for a range of frequencies 7·5 and 52·5 MHZ.

The volume is priced at Rs. 6 or 10*sh*. per copy.

B. S. M.
C. S. V.

The Central Board of Irrigation in India

THE recent publication of the Central Board, *Annual Report for the year* 1936-37, not only gives the public an idea about the work that the Board is carrying on, but shows what different provinces of India are doing by way of research on problems of Irrigation. The Board provides facilities for workers from different provinces to meet together once a year and to compare notes. As its President Mr. G. M. Ross said in one of these meetings, "This annual meeting affords a splendid opportunity for Irrigation Engineers from various parts of the country who are particularly interested in research, to discuss both formally and informally, the many problems that beset irrigation engineers not only in India, but in other irrigating countries of the world. By constructive criticism of the various experiments in progress in these provinces which have Research Stations and discussion of other problems of common interest, we are afforded the best possible means of applying the combined knowledge and experience available in the country to those problems which are so important to the many million engaged in cultivation aided by irrigation. You are aware that India has a much greater area under irrigation than any other country in the world and in fact, it is equal to the total area irrigated by the next five leading countries including America".

Of the various subjects discussed in the Research Officers' meeting of the Board, the following appear to be of all-India importance:—

(1) The Role of Reservoirs in River Flood Control.

(2) Meandering of Rivers.

Discussion on these two subjects seems to have lead nowhere. It is true very little information is available about them but that is no reason why efforts should not be made to study these problems. Much of the prosperity of the country depends on flood control. During recent years we have witnessed catastrophic floods all over the country and thousands of lives and hundreds of villages have been washed. It is time that something substantial is done to increase our knowledge about these two subjects so that we can grapple the problem more effectively. A River Commission on an all-India basis is what is called for—where engineers from different provinces and a few scientists may sit together and devise means to combat the evil.

The work that is being carried out at different research stations will now be reviewed.

PUNJAB

In the Punjab, Irrigation Research is carried on under the direction of the Director, Irrigation Research. Besides the laboratory at Lahore, he has a River Model Laboratory at Malikpur and a number of silt laboratories at the headworks of various canal systems of the Province. The following problems appear to be of more than local interest.

It is well known that cavities do form under weirs or similar hydraulic structures and many disastrous failures had been due to these. It is a very vital problem to the irrigation authorities to prevent, if possible, or to detect the formation of such cavities below weirs. Punjab research workers seem to have been fully alive to the dangers of this problem and we find them busy with the following researches:—

1. *Design of Weirs on Sand Foundations.*—In this experiment, mathematical, experimental and field workers have combined and succeeded in replacing Bligh by a much sounder method of design. It is hoped that this method will be successful in preventing the formation of cavities below weirs. But for existing weirs it is necessary to detect defects under them.

2. *Cavities under Weirs.*—During the year under review, an investigation has been in progress to determine whether it is possible to devise a method for detecting defects and cavities under weirs. The principle employed is that wireless waves are partially reflected from any surface of discontinuity and when coming from different distances would reach an aerial in different phases. The composite reflected wave can be analysed by means of a cathode-ray oscillograph operated with a high frequency time base and from the nature of the reflection it is possible to infer defects.

3. *Effect of Silt and Temperature on Discharges.*—It is a common belief among irrigation engineers that the silt content and temperature of flowing water affect the discharge as measured by rectangular or a broad crested weir. For this purpose an experiment was set up in which the discharge in a flume was measured by current meter, a rectangular weir and by a measuring tank. It was possible to have all shades of water from clear to grey, brownish grey and then finally brown. A range of water temperature from 12° C. to 25° C. was also met with. Reynold's Number (R_e) for these experiments was above 10^5. Discharges in the rectangular weir were calculated by Rehbock's formulæ.

The experiments shewed that within the limits of experimental error variation in the temperature and silt content of the water did not produce any appreciable difference in the discharge measured by a rectangular weir and the velocity meter.

CENTRAL STATION

Central Hydrodynamic Research Station at Khadakavasla near Poona

Experiments at this station had been mostly on Falls and on Rivers. Various types of falls had been tested at their station. Of these, the following are some of the well-known ones:—

1. Proportional standing wave flume meter fall with sides downstream of the fall diverging at 1 in 10, 1 in 5.

2. Proportional standing wave flume meter fall with curved divergences downstream.

3. Weir falls—free over fall type.

4. Weir falls with glacis, cistern of arrows and control blocks.

5. Weir fall with glacis, baffle, bowed cistern and deflector.

6. Notched Falls.

Notched falls (Punjab type) were more costly than any other design and also gave inferior results, so may finally be discarded.

The flume fall with friction block according to a design by Mr. Montagu was about 7 per cent. more expensive than the standard flume fall design.

The choice would then lie between a Plain Weir or a weir with downstream glacis slope and

(*a*) arrows and control blocks, or

(*b*) baffle and deflectors.

These experiments have shown that the latter are cheaper and better.

Experiments with large-scale model of the Gauges at the Hardings Bridge (the horizontal scale = 1/500) on effect of length of guide banks on flow (for the Railway Board)

The Hardings Bridge Committee at their meeting in November 1935 decided that the guide banks of the Hardings Bridge, which are 2,850 ft. long = 0·53 times the length of the bridge should ultimately be extended to 5,385 ft. the length of the bridge. The experiments were done with both Right and Left Guide Banks extended equally, Damukdia Guide Bank being removed.

The conclusion was that Sir Francis Spring's design should be adopted.

Bombay

This station does not now deal with hydraulic problems. It is more concerned with soil research.

1. *Soil Type in the Deccan Canal tracts and their behaviour under irrigation.*—It comprises the study of typical soil profiles, the physico-chemical changes caused by irrigation and high subsoil water levels and the reclamation of soil tilth of damaged lands after drainage.

Similar work seems to have been done at the Padigaon Sugarcane Research Station by Dr. J. K. Basu and M. S. S. Sirur.[1] It will be interesting to compare their conclusions.

United Provinces

The following results are of more than local interest:—

1. *Treatment of canal beds with molasses.*—For staunching canal beds sugar factory bye-products were used but no successful results seem to have been obtained.

2. The correlation coefficient between the discharge of the Ganges River below the off-take of the Ganges River at Headwork and at Narora have been worked out for the month of December to May inclusive, for the years 1929–30 to 1935–36.

The conclusion stated mathematically is that if discharge of the Ganges River at Narora be taken as a function of several variables, this function is independent of discharge of the Ganges River at Hardwar in dry weather month. This conclusion seems to be surprising and requires more thorough examination.

Sind

During the current year the work of the Development and Research Division was carried out under the following heads:—

1. *Model experiments.*—Various models on regulators and falls were experimented upon.

2. *Collection of Hydraulic data on Barrage Canals.*—Out of 74 sites with discharge varying from 20 to 10,000 cu/sec. only about 22 sites had a fairly steady bed as seen from the observations of the last four years. From these 22 sites only 3 sites satisfy Lacy's two criteria, *viz.*, $P_w = 2{\cdot}67\,Q^{1/2}$ and $V = 16\sqrt[3]{R^2S}$ within 10 per cent. and as such no conclusion could be drawn from the data.

Instead of rejecting these data of 22 sites as being untrustworthy because they do not satisfy Lacy's equation, it would have served the cause of science better if Sind had tried to develop their own relations from them.

No new station has been opened in any other provinces since the last report of 1935–36 was out. It is time that provinces like Bengal, Bihar, Orissa and Madras should have their own stations. If they cannot afford to have a separate station each, Bengal, Bihar and Orissa whose problems are more allied in nature and interconnected, may have a common research station at a central place.

[1] See "Soils of the Deccan Canals—I. Genetic Soil Survey and Soil Classification. Nira Right Bank and Prarara Canals", *Indian Journal of Agricultural Science*, Oct. 1938, 8, Part V.

INDUSTRIAL SECTION

Power Alcohol in India

By Dr. N. G. Chatterji

(Harcourt Butler Technological Institute, Cawnpore)

Introduction

THE problem of using alcohol as liquid fuel in internal combustion engines has long been engaging the attention of the people in India, and as far back as 1918, the Indian Industrial Commission, under the Chairmanship of Sir Thomas Holland, made recommendations regarding power alcohol in the following words:—

"On several occasions our attention was drawn to the possibility of making industrial alcohol from hitherto neglected vegetable materials, some of which appear to be sufficiently promising to justify investigation and experiment. We recommend that a more liberal policy should be followed by the excise authorities in respect of the class of denaturant prescribed, and more regard might be paid to the likelihood rather than to the mere possibility of frauds to the revenue, when the requirements of the commercial users conflict with excise regulations."

In pursuance of the above recommendation, the Government of India passed a resolution on October 1, 1927, to the effect that power alcohol should not be handicapped by the imposition of any excise duty except such as should be leviable upon any fuel adjunct which is separately liable to duty. It may therefore be concluded that the desirability of encouraging the use of power alcohol in the form of alcohol-petrol mixed fuel had been recognised by the Government even at a time when the entire production of molasses in India was being otherwise consumed, and there was no likelihood of any surplus quantity becoming available in the near future for the manufacture of power alcohol.

Availability of Raw Material.

Alcohol is essentially an agricultural product, as it can be manufactured from potatoes, beet, cereals, molasses, etc.; in fact from any product containing sugar and starch. Thus, potato forms the chief raw material for alcohol in Germany, beet and molasses in France and Czechoslovakia, maize in U.S.A., and molasses in almost every country. India is therefore most favourably situated so far as the availability of the raw materials is concerned, for, in addition to an inexhaustible supply of cheap cereals, molasses are now available in the country at a nominal cost to the extent of about 200,000 tons per year. Indeed, the disposal of this surplus quantity of molasses, for which at present there is no market, is one of the acute problems in the sugar industry and strangely enough, it is this problem which has brought into prominence the question of power alcohol manufacture in India.

The following table gives the figures for the production of molasses by central factories working with cane:—

Production of Molasses by Central Factories Working with Cane

	1937–38 tons	1936–37 tons	1935–36 tons	1934–35 tons	1933–34 tons	1932–33 tons
U.P.	215,700	207,900	182,600	125,500	110,052	64,000
Bihar	80,800	133,700	97,200	71,900	61,000	57,900
All India ..	364,000	414,600	337,100	233,900	190,400	130,400

It is therefore estimated that some 12 million gallons of power alcohol can at once be produced from surplus molasses, without reckoning into account the quantity that may become available with the progress of prohibition in the country and the better marshalling of such resources as mohua flowers, cane tops, etc.

At one time, hopes were entertained that a substantial quantity of molasses would be exported out of the country, but the working

of a number of years has shown that in spite of substantial facilities given, the export scheme has been a virtual failure. The average price for molasses received by the sugar factories was about anna 1 and pies 2 only per maund, while even at this price, the exporting company declared the value of molasses on board the ship at Calcutta to be annas 7–11 per maund. It is understood that some of the distilleries favourably situated in the cane factory areas in the U.P. and Bihar have contracted for the supply of molasses at annas 2 per maund delivered at the distillery, while annas 4 per maund will be considered quite a satisfactory price by the sugar factories.

Method of Manufacture of Alcohol

Alcohol is manufactured by the rectification of the dilute solution obtained after the fermentation of sugar- or starch-bearing materials is complete. The usual strength of this fermented wash, as it is generally called, is about 6–8 per cent. Due to certain peculiar properties of a solution of about 96 parts by volume of alcohol and 4 parts of water, this is the maximum strength of alcohol that can be obtained by straight rectification of the 'fermented wash'.

The manufacture of industrial alcohol is, at present, being carried out in all distilleries in India equipped with patent continuous stills. In fact, the alcohol as it comes out of these stills, is what is known as 'rectified spirit' and the strength varies generally from 90 per cent. to 96 per cent. by volume. The subsequent manipulation of this spirit in warehouses by the addition of water, chemicals, or other substances, converts it into various forms of drinking spirit, 'methylated spirit', or 'specially denatured spirit'.

Further dehydration of rectified spirit was till recently a matter of considerable difficulty, and the usual process of getting 'absolute alcohol' was by distillation with lime. This was a costly process and entailed considerable losses in working. But within the last fifteen years or so, at least two different processes have been developed and have met with considerable commercial success. These are commonly known as the azeotropic process and the salt-dehydration process. The following table (*International Sugar Journal*, March 1938) gives the present annual production of absolute alcohol by these processes:—

World Production of Absolute Alcohol (1937)

I. Azeotropic Process

		Hectolitres*
(*a*) Melle system	..	5,250,000
(*b*) 'Drawinol' system	..	3,000,000
Total	..	8,250,000

II. Salt-Dehydration & Other Processes

		Hectolitres
(*a*) Hiag system (alkali acetates)	..	3,975,000
(*b*) I.G.F. system (gypsum)		265,000
(c) Merck Pressure system (lime)	..	120,000
Total	..	4,360,000

Importance of Commercial Dehydrated Alcohol

It may well be asked what was the necessity for the commercial manufacture of cheap dehydrated alcohol. The reason is, that dehydrated alcohol has a much wider range of miscibility with petrol than rectified spirit, which is found to be unsuited for the preparation of alcohol-petrol mixtures, in the proportions in which such mixtures were found to be suitable as motor car fuel. Mixtures of rectified spirit with petrol tend to separate easily. On the contrary, mixtures made with dehydrated alcohol and petrol have been found to be stable and perfectly satisfactory for all practical purposes.

As dehydrated alcohol is now almost exclusively used for the generation of power and as recent researches have evolved processes so that now there is little difference between the cost of manufacture of dehydrated alcohol and rectified spirit, 'power alcohol' has now become almost synonymous with dehydrated alcohol. It seems, therefore, that for power purposes the use of denatured rectified spirit of about 90 per cent. strength is an anachronism and should be given up.

Cost of Manufacture of Absolute Alcohol (power alcohol).—The estimated cost of manufacture of power alcohol (absolute strength) prepared directly from fermented wash by the fourth technique of Usines de

* Hectolitre = 22 gallons.

Melle azeotropic process, and for a plant of about 1,550 gallons per day are given below:

		Per gallon Pies
1.	Cost of steam .. (32.5 lbs. at 0.22 pie per lb.)	7.15
2.	Cost of cooling water, power, light, etc. ..	0.84
3.	Cost of chemicals .. (Acid, nutrients for yeast, etc.)	3.00
4.	Cost of entraining liquid for dehydration .. (0.00045 gallon at Rs. 3–4 per gallon)	0.28
5.	Cost of alcohol lost in dehydration .. .. (0.15% at As. 4–6 per gallon)	0.08
6.	Wages of labour and staff	7.60
7.	Cost of management ..	3.10
8.	Licence fee for the patent rights	0.20
9.	Depreciation charges ..	10.70
10.	Warehouse charges ..	1.80
	TOTAL (excluding cost of molasses) ..	34.75

It is therefore possible to manufacture power alcohol in the U.P. and Bihar sugar factory areas, in central distilleries at a cost of about annas 4–6 per gallon, after paying for molasses at annas 4 per maund delivered at the distillery.

Alcohol Fuels Suitable for Motor Cars.—It has now been established beyond dispute, both by careful bench experiments and long usage amongst the public, that mixtures of petrol and absolute alcohol within certain definite proportions are just as satisfactory fuels, if not better, as straight petrol. The optimum proportion of alcohol in the mixture would naturally depend upon the quality of the petrol, the make of the engine, the average atmospheric conditions of the country where the fuel is used, and similar other considerations. However, there is general agreement that fuels containing high portions of alcohol (25 parts in 100 parts of mixed fuel) and likely to give some trouble when used in cold countries would be found quite satisfactory in tropical countries like India.

ALCOHOL FUELS AND POWER DEVELOPMENT

Heat Value of Combustible Mixtures in the Engine and Power Output.—Pye, in his *Internal Combustion Engine* (1931, p. 54), has shown that the calculated power of an engine would be proportional to the heat generated per standard cubic foot of the mixture sucked into the cylinder, multiplied by the volume ratio on combustion, which is the ratio of the number of molecules of the various products of combustion to those of the combustible mixture. This may be regarded as potential source of increased power from an engine; the higher the ratio, the greater the assessment of the value of the mixture as a working substance.

By way of illustration, we may take the cases of heptane, C_7H_{16} of calorific value 10,700 C.H.U. per lb. and ethyl alcohol, C_2H_5OH, of 6,540 C.H.U. per lb. The combustion of the correct fuel-air mixtures, together with the heat generated, are as follows:—

(i) $2\ C_7H_{16} + 22\ O_2 + 82\cdot 8\ N_2 = 14\ CO_2 + 16\ H_2O + 82\cdot 8\ N_2 + 2\cdot 155 \times 10^6$ C.H.U.

(ii) $2\ C_2H_6O + 6\ O_2 + 22\cdot 6\ N_2 = 6\ H_2O + 4\ CO_2 + 22\cdot 6\ N_2 + 0\cdot 605 \times 10^6$ C.H.U.

Hence, the quantities of heat generated per mol of the fuel-air mixtures are:—

(i) For heptane:—

$$\frac{2\cdot 155 \times 10^6}{106\cdot 8} = 20{,}180 \text{ C.H.U.}$$

(ii) For alcohol:—

$$\frac{0\cdot 605 \times 10^6}{30\cdot 6} = 19{,}750 \text{ C.H.U.}$$

Taking into consideration the volume ratio of the products of combustion to the initial gas mixtures, the total energy of the fuel-air mixtures would be:—

(i) For Heptane, with a volume ratio of $\frac{112\cdot 8}{106\cdot 8}$ or $1\cdot 056$:—

$$20\cdot 108 \times 1\cdot 056 \times \frac{1\cdot 400}{359} = 83{,}100 \text{ ft.-lb.}$$

per standard cubic foot.

(ii) For Ethyl alcohol, with a volume ratio of $\frac{32\cdot 6}{30\cdot 6}$ or $1\cdot 065$:—

$$19{,}750 \times 1\cdot 065 \times \frac{1400}{359} = 82{,}200 \text{ ft.-lb.}$$

per standard cubic foot.

It would thus be seen that even though the calorific value of a substance is considerably lower than that of another, the correct combustible fuel-air mixture may have practically equal energy content on account of a smaller proportion of air

required for combustion and consequently lesser dilution with the inert nitrogen. It is rather interesting to find that in the case of all the more common liquid fuels, the energy content of a correct mixture is almost identical, as shown in the following table compiled by Ricardo:—

Substance	Specific Gravity at 15° C.	Lower Calorific value in C.H.U.		Latent Heat of evaporation C.H.U. per lb.	Ratio by weight in correct mixture	Volume ratio on combustion	Heat liberated per S.C.F. of correct mixture C.H.U.	Total energy per S.C.F. of correct mixture C.H.U.
		per lb.	per gallon					
Petrol	0·76	10,430	79,200	73	14·6	1·047	57·0	59·7
Heptane (97 per cent.) ..	0·69	10,700	73,900	75	15·1	1·056	56·9	60·1
Benzol	0·88	9,640	85,200	95	13·2	1·013	57·6	58·4
Ethyl Alcohol (pure) ..	0·79	6,540	51,800	220	8·97	1·065	56·6	60·3
Rectified Spirit (95 per cent.) ..	0·815	6,040	48,900	246	8·4	1·065	54·5	58·0

Power Development in Motors

The development of power in motors depends a good deal upon the construction and working of the carburettor. The work of Ricardo, Hubendick and others has established the following facts and general relationships:—

(1) With most fuels, starting with low revolution speeds, the power developed at first rises quickly, reaches a maximum, and then falls down when the rate of revolution is still further increased.

(2) The maximum power is developed when the ratio of fuel to air is higher (4–6 per cent.) than that necessary for complete combustion.

(3) The maximum efficiency is obtained when the ratio of fuel to air is lower (about 4 per cent.) than the correct mixture.

(4) With alcohol the increase in power is very marked—much more than with petrol—amounting to nearly 10 per cent. with very rich mixtures.

(5) For smoothness and flexibility in running, multi-cylinder engines must be fed with mixtures slightly on the over-rich side.

Comparison of the Properties of Petrol and Alcohol-Petrol Mixed Fuel in Motor Car Engines.—Prof. Hubendick contributed a paper to the World Power Conference, London, 1928, on the 'Use of Ethyl Alcohol as Motor Fuel' (*Transactions*, 3, 724–48), based on the results of an exhaustive series of comparative experiments with petrol and petrol mixed with varying amounts of alcohol. For each mixture, the effect and the consumption of fuel per horse-power-hour for different sizes of the carburettor jet were registered graphically. The following is a summarised extract of a part of his paper:—

"Series of experiments were carried out with undiluted gasoline and with gasoline mixed with 10, 15, 20, 25 per cent., etc., of alcohol; for each type of fuel, tests were made with different sizes of carburettor jets. The series of graphs obtained in this manner is very instructive. It shows that, with a minimum fuel consumption, the results of the experiments with undiluted gasoline and with gasoline containing 10, 15 and 20 per cent. of alcohol very nearly coincide. In reality, the heat consumption decreases slightly within the above limits, as the percentage of alcohol in the fuel increases, although the difference is very small. Hence in the case of a carburettor adjusted for use with gasoline, not more than 23 per cent. of alcohol must be present in the gasoline-alcohol mixture, if good results are to be obtained. This fact can be explained by assuming that the characteristic properties of the alcohol, do not exert themselves appreciably until the proportion of the alcohol has increased to 23 per cent. If the percentage of alcohol be still further increased, the physical properties of the alcohol commence to exert their influence, and it becomes necessary to readjust the carburettor. It may be mentioned that the results given above do not refer to those obtained on one engine only, but are entirely consistent with results obtained with different types of motors, showing only slight variations in actual quantities.

"Summarising, it has been shown that gasoline can be mixed with alcohol in such proportions that the mixture contains upto 25 per cent. of alcohol without this proving

detrimental to its use as fuel for petrol engines. It is therefore possible to use such a mixture in these engines without taking special precautions, and to obtain with it results as good as those obtained when using gasoline. To verify this statement, tests have been made in automobile engines of different makes and running under climatic conditions unfavourable for the use of alcohol mixture, that is, at a low air temperature. These experiments have shown that the engine runs as well on such a mixture as it does on gasoline alone, and that the driver has been unable to say which fuel was being used."

Experiments performed by Lichty and Phelps at the Yale University, and published in the *Industrial and Engineering Chemistry*, February 1938, confirm in a general way these results obtained by Prof. Hubendick. They write as follows:—

"Applying the multicylinder power and fuel consumption data to motor vehicles on the highway, and using air-fuel ratios equal to or richer than maximum power for gasoline and without adjustment of air-fuel ratio on substitution of the 10 and 20 per cent. blends, a decrease in volumetric fuel consumption of about 2 and 3 per cent. for the 10 and 20 per cent. blends respectively, should be obtained."

The following table gives the results of the experiments:—

Comparative Road Tests with Petrol and Alcohol-Petrol Mixed Fuels

The only carefully conducted experiment done in India was by Mr. J. Charlton, Agricultural Chemist to Government of Burma (now Director of Agriculture). The following is extracted from the *Agricultural Survey Bulletin No. 24 of 1936*, Department of Agriculture, Burma:—

"Absolute alcohol-petrol fuels not being available in Burma, in January 1935 the writer prepared such mixture on a small scale in the laboratory and tested them in a 20.9 H.P. car using a special small tank, so that consumption could be accurately recorded. The carburettor had been previously adjusted for economy and was not altered in any way for the tests. A circular course of approximately eight miles was arranged to minimise wind resistance effects and as far as possible a steady speed of 25 m.p.h. was maintained. Results were as follows:—

	Miles per gallon	Equivalent to
(1) Burma Oil Company Petrol (Pump) ..	21.13	100
(2) 15 : 85 mixture ..	22.50	101.5
(3) 25 : 75 mixture ..	22.73	107.6

Maximum speed was in all cases 57 m.p.h. and no difference could be distinguished in

Brake Thermal Efficiencies (in per cent.) at Comparable Conditions

Fuel	Maximum Power			Richest complete combustion		
	1,000 r.p.m.	2,000 r.p.m.	3,000 r.p.m.	1,000 r.p.m.	2,000 r.p.m.	3,000 r.p.m.
			Full Load			
Gasoline	20·3	21·4	19·6	22·8	24·0	22·0
10 per cent. Blend	20·7	21·2	19·7	23·2	24·4	21·5
20 per cent. Blend	21·4	22·0	20·0	24·0	24·8	22·2
			Two-thirds Load			
Gasoline	18·0	18·7	17·4	22·2	21·2	19·0
10 per cent. Blend	18·8	18·8	16·9	21·6	21·2	18·8
20 per cent. Blend	19·5	19·0	17·4	21·8	20·5	19·2
			One-third Load			
Gasoline	14·1	14·1	12·4	15·9	14·2	..
10 per cent. Blend	14·0	13·9	12·3	16·1	13·3	..
20 per cent. Blend	14·4	13·9	12·6	15·0	14·2	..

acceleration from 10–30 m.p.h. Speed and acceleration tests were mean results obtained by running in opposite directions. It was noticed that with the 25 : 75 mixture it was impossible to make the engine pink (detonation); the 15 : 85 mixture was almost free from tendency to pink while using petrol alone careless opening of the throttle caused severe pinking. The car had done a considerable mileage at the time of the test and was in need of decarbonisation and valve grinding. The greater economy of the alcohol-petrol mixtures was beyond all doubt and driving was very much simplified since pinking disappeared."

Excise Duty and Power Alcohol.—Under the new Government of India Act of 1935, the revenue from excise duty on petrol and on alcohol destined for power or industrial purposes goes to the Central Government, who at present are firm in their decision to levy the full amount of excise duty on power alcohol as on petrol. The Provincial Governments which are vitally interested in the development of the alcohol industry are therefore confronted with this serious question of competing with imported petrol *on equal terms*—a situation which is unique in the world history of power alcohol. However the recent decision of the Federal Court of India regarding the powers of the Provincial Legislature to impose a sales tax on motor spirits may help the cause of power alcohol in those provinces which are vitally interested in the question of finding an important and economically sound outlet for surplus molasses.

CONCLUSION

Some interesting information regarding power alcohol and its use in other countries are given below:—

1. *Comparative Prices of Power Alcohol in Various Countries in 1936*

(Tokayer, *World Petroleum*, June 7, 1936)

COUNTRY	Price of Power Alcohol per gallon — In American Cents	Price of Power Alcohol per gallon — Equivalent in Indian Currency
		Rs. A. P.
1. Austria	57	1 10 3
2. Czechoslovakia ..	76	2 3 0
3. France	27	0 12 6
4. Germany ..	76	2 3 0
5. Hungary ..	79	2 4 4
6. Italy	88	2 8 6
7. Jugoslavia ..	40	1 2 5
8. Latvia	59	1 11 2
9. Poland	19	0 8 9
10. Spain	52	1 7 11
11. Sweden	31	0 14 3

2. *Consumption of Power Alcohol in Various Countries*

(*Ind. & Eng. Chem.*, News Edition, July 20, 1936)

COUNTRY	Year	Quantity in Imperial gallons	Remarks
1. Austria ..	1934	1,018,000	
2. Brazil ..	1935	10,455,000	65,472,780 in 1936
3. Cuba ..	1934	2,367,000	
4. Czechoslovakia ..	1934	13,190,000	
5. France ..	1934–35	81,524,000	
6. Germany ..	1936–37	40,121,000	
7. Hungary ..	1934	2,106,000	
8. Italy ..	1934	1,402,000	Rapid increase since 1934
9. Latvia ..	1934	1,350,000	
10. Poland ..	1934	1,700,000	
11. Spain ..	1935	2,400,000	
12. Sweden ..	1934	2,400,000	
13. United Kindgom	1935	1,242,000	

3. *Power Alcohol Plants Installed in Various Countries*

COUNTRY	Azeotropic Process* No.	Azeotropic Process* Capacity per day	Salt-Dehydration Process† No.	Salt-Dehydration Process† Capacity per day
		(In Hectolitres)		(In Hectolitres)
1. Argentine ..	1	300	..	..
2. Australia ..	1	150	..	..
3. Austria ..	1	220	..	..
4. Belgium ..	3	400	..	..
5. Bulgaria ..	..	..	2	180
6. Brazil ..	13	2,750	3	190
7. Chili ..	2	120	..	..
8. Columbia ..	..	..	2	60
9. Czechoslovakia ..	24	3,236	14	1,360
10. Denmark ..	1	40	..	..
11. England ..	3	580	..	..
12. France ..	45	14,535	2	1,200
13. ,, Colonies ..	5	430	..	..
14. Germany ..	10	3,900	1	300
15. Holland ..	1	3	..	..
16. Hungary ..	6	700	..	..
17. Irish Free State	5	150	..	..
18. Italy ..	14	3,455	1	40
19. Lettonia ..	2	440	..	..
20. Lithuania ..	1	75	..	..
21. Panama ..	1	40	..	..
22. Poland ..	3	530	..	..
23. Portugal ..	1	60	..	..
24. South Africa ..	3	360	1	60
25. Spain ..	1	30	4	900
26. Sweden ..	1	30	2	180
27. Yugoslavia ..	5	425	2	280
TOTAL ..	153	32,959	34	4,750

* Information available upto the end of 1936.

† Information available upto 1935.

4. *Alcohol-Petrol Mixed Fuels in Different Countries*

Country	Commercial name of the mixed fuel	Composition			Whether alcohol mixing is compulsory
		Petrol	Benzol	Alcohol	
1. Austria	..	..	80–60	20–40	Yes.
2. Australia ..	Shellkol	85	..	15	No.
3. Brazil	..	..	..	..	Yes.
4. Bulgaria	..	75–70	..	25–30	Law not enforced.
5. Chili	..	..	..	..	Yes.
6. Cuba	Mofuco	37	3	60	No, but favourable.
7. Czechoslovakia ..	Dynalkol (i)	80	..	20	..
	(ii)	70	4	26	Yes.
8. Denmark	..	75	..	25	No, but State monopoly.
9. England	Cleveland Discol	70	15	15	No, but favourable.
10. Equador	..	80	..	20	Yes.
11. France	..	Various Proportions			Yes, State monopoly.
12. Germany	Monopoline	Various Proportions			Yes, State monopoly.
13. Hungary	Motalko	80–70	..	20–30	Yes.
14. Italy	..	80	..	20	Yes.
15. Lettonia	Latol (i)	50	..	50*	
	(ii)	67	..	33†	Yes, State monopoly.
16. Lithuania	Motorin	75	..	25	Yes.
17. Natal	Natalite	50	..	50	No, but favourable.
18. Panama	..	80	..	20	No, but favourable.
19. Philippines ..	Gasenol	70	..	30	..
20. Poland	(i)	85–70	..	15–30‡	..
	(ii)	15–30	..	85–70§	No, State monopoly.
21. Sweden	Lattbentyl	75	..	25	No, but favourable.
22. Yugoslavia ..	..	80	..	20	Legislation favourable.

* Summer Time Mixture. † Winter Time Mixture.
‡ For Motor Cars. § For Tractors.

Ragi, *Eleucine coracana* Gaertn.,—A New Raw Material for the Malting Industry

BARLEY, *Hordeum sativum*, occupies the pride of place among the cereals as raw material *par excellence* for malting both in the brewing and the food industries. Attempts have been made, from time to time, to employ other cereals, wheat, rye, rice, etc., but none of these has, to any serious extent, affected the pre-eminent position occupied by barley.

While it is possible that there are sound reasons for its continued employment in a highly specialised field such as the brewing industry, the possibility of substituting or supplementing barley in the food and pharmaceutical industries deserves careful consideration. This problem is of particular interest to India where barley is by no means an extensive crop, only a little over 6 million acres, confined to four provinces (United Provinces, Bihar, Orissa and the Punjab) in North India, being under cultivation. Barley is not cultivated in South India except, perhaps, for a small tract in the Nilgiris. The three principal millets of India, *viz.*, *cholam* (*Andropogon sorghum* Brot.), *bajra* (*Pennisetum typhoideum* Rich.) and *ragi* (*Eleucine corcana* Gaertn.), together occupy over 57 million acres, and any possibility of employing these starchy food grains in the malting industry demands special consideration. India imports, annually, over Rs. 24 lakhs worth of farinaceous and invalid foods of which malt is the primary constituent, and for these reasons, investigations on the malting of the more abundantly available cereals is of interest to India, in general, and to South India, where barley is not cultivated, in particular.

Work in this field was first started in the Agricultural Research Institute, Coimbatore, in 1917. At the Madras Exhibition, 1917, the Government Agricultural Chemist exhibited a number of malted foods, containing the malts prepared from *cholam* and *ragi* as the essential ingredients.[1] Investigations relating to malting have continued to occupy the attention of the Agricultural Research Institute, Coimbatore, ever since.

The relative merits of *cholam*, *bajra*, *ragi* and other locally available millets were examined by Viswanath, Rao and Ayyangar,[2] who reported that while both *cholam* and *ragi* could be adapted for malting, the former is to be preferred in view of the bigger size of the grain and the absence of any tendency to felt in the malting tray.

Investigations relating to the chemical examination of Indian foodstuffs were initiated by Prof. Roland V. Norris, at the Indian Institute of Science, Bangalore, in 1925. The work was carried out under two main lines, (1) the isolation, analysis and biological assay of the proteins of the foodstuffs, and (2) the study of the enzymes of the resting and germinated materials. The studies revealed that *ragi* contained a prolamin of high biological value[3] and that germination led to the production of a highly active diastase, more potent than that from *cholam*. These two observations prompted the Institute workers to re-examine the malting qualities of *ragi* with a view to manufacture from it a satisfactory malt extract suitable for employment in the food and pharmaceutical industries.

Eleucine coracana, *ragi*, is an extensively cultivated millet occupying over 7 million acres, of which nearly 72 per cent. lies in Madras and Mysore. It is the premier crop of the Mysore State, and is perhaps the cheapest food grain on the market, with a traditional reputation as a nutritious and sustaining food. A variety of *eleucine* is cultivated in Africa and feeding experiments conducted by Orrù[4] have shown that rats, maintained exclusively on a diet of *eleucine*, kept in good condition and showed a considerable increase in weight (209 per cent. average increase in 65 days). Camis[5] studied the vitamin content of *Eleucine coracana* and records that pigeons fed on

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[1] Sivan, *The Agric. J. India*, 1919, **14**, 71.

[2] Viswanath, Rao and Ayyangar, *Mem. Dep. Agr. Indic, Chem. Ser.*, 1918, **5**, 117.

[3] Niyogi, Narayana and Desai, *Ind. J. Med. Res.*, 1934, **22**, 373.

[4] Orrù, *C. A.*, 1929, **23**, 3753.

[5] Camis, *Ibid.*, 1935, **28**, 6781.

vitamin B_1-free diet recovered in 2–5 days after feeding on *ragi*. Luigi Massa[6] mentions that *E. coracana* is employed for preparing a fermented liquor, similar to beer, in Africa. The protein of *ragi* contains phosphorus, and recent work[7] at the Nutrition Research Laboratory, Coonoor, has shown that among the cereal proteins, the one from *ragi* is the best for the maintenance of the adult rat.

From what has been said above, it will be seen that the merits of *ragi* as a raw material for malting, assert themselves for consideration, and the work carried out at the Institute, which has now reached a successful stage, was directed to a study of the conditions necessary for obtaining maximum transformation during the malting of the grain.

The sequence of operations leading to the production of malt runs as follows:—40 hours steeping, flooring for 5–6 days, controlled kilning for 24 hours and final curing at 95° C. for 30 minutes. The resulting malt has an extremely agreeable aroma, yields 74 per cent. extract and possesses good keeping qualities.

The smallness of the grain necessitates a thick spread (3") of the grain with frequent ploughing to ensure evenness of germination. Drum germination gives better results. Under these conditions there is no tendency to felt and a uniformly germinated product results. The smallness of the grain is a decided advantage in kilning, tending not only to minimise fuel costs but also ensuring uniform drying. Under properly controlled conditions, the malting loss does not exceed 15 per cent.

Malt products.—Extract. Conditions for preparing malt extract have been worked out. Best results are obtained by percolation at 70° C. with water added in proportion of 1 part of broken malted grain to 8 parts of water. Final filtration in a Seitz filter gives a water-clear extract containing nearly 10 per cent. total solids. Several semi-commercial-scale trials have been successfully conducted in the Department. More recently, concentration of one batch of malt liquor has been carried out in Scott's patent Forced Circulation Evaporator, which was made available to us through the kind courtesy of the Government Industrial and Testing Laboratory, Bangalore. A clear, honey-coloured product, ref. index 1·4906 at 25° C., and Sp. Gr. 1·40 at 25° C. was obtained.

The nitrogen content of the extract was found to be 3·5 per cent., somewhat below the specification given in the *British Pharmacopœia*. This is due to the fact that *ragi* (H. 22) employed for this work is poor in nitrogen. A number of varieties of *ragi*, obtained through the kind courtesy of Rao Bahadur G. N. Rangaswami Ayyangar, Millet Specialist, Government of Madras, have since been examined for their nitrogen content, and two varieties, E.C. 1540 and E.C. 2928, with nitrogen contents of 2·27 and 1·83 respectively, have been selected for malting trials. It is pertinent to point out that both these varieties are white, and possess good malting qualities.

I should like to associate with this investigation, the names of Messrs. N. Narayana, A. Krishnamurthy and more recently Mr. S. Srinivasa Rao. Special mention, however, must be made of Mr. A. Krishnamurthy, who was largely responsible for determining the optimum conditions for malting. A variety of invalid and "vitaminised" malt foods were exhibited at the Mysore Dasara Exhibition, 1935. These researches would not have reached the present stage, but for the enthusiastic co-operation of Mr. M. Sreenivasaya, the keen interest evinced by Sir C. V. Raman, and the kind and continued encouragement of Rao Bahadur B. Venkatesachar.

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[6] Massa, *Ibid.*, 1935, **29**, 6959.
[7] Swaminathan, *Ind. J. Med. Res.*, 1938, **26**, 113.

Some Aspects of the Indian Sugar Industry*

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(General Manager, Mysore Sugar Co., Ltd.)

THE development of the modern Indian Sugar Industry has been spectacular. It has been my privilege to be closely connected with similar rapid development and modernisation of an indigenous sugar industry in the Philippines and in South China, but the development in India has been unique in many respects.

To begin with, many laymen have contributed to this progress and in spite of this, the industry in India has reached a very creditable grade of efficiency in a comparatively short time.

A young industry like the Indian sugar enterprise will naturally be compared with similar and older industries elsewhere. Indeed, severe criticism has been launched against the Indian industry, especially by sugar interests in Java. A leading article in a Dutch newspaper was headed "Protection produced deception". The writer bitterly ruminates on the loss of the Java sugar export trade to India, which at its optimum exceeded 10,00,000 tons annually. This has now been reduced to about a tenth of this, and the decline is continuing. The article alleged, amongst other things, that the Indian industry, through protection, had grown far too quickly; that a large amount of capital had been invested without adequate returns and that investors blamed the Government and demanded more and yet more protection. However, the facts and expectations of the first Tariff-Board, embodied in their report were as follows:—

(1) That the price of imported Java sugar would drop to Rs. 4 per maund and, perhaps, to Rs. 3–4 per maund.

(2) That in case the price of Java sugar should drop below Rs. 4 per maund, the duty should be increased by 8 annas.

(3) That the reasonable sales price of Indian sugar during the period of protection, should be Rs. 8–13–0 per maund.

(4) That the average recovery of Indian factories at the end of the period of protection would be 9·4%.

The protection given to the sugar industry in India, was principally aimed at betterment of the cultivators' conditions. This is very obvious, because as soon as the new mill-owners were reaping large profits under cover of the protective tariff and low cane prices, the Government of India nearly killed the industry, first by levying an exorbitant excise duty and later by regulating the cane prices. The excise duty was, in my opinion, indefensible, but it was the easiest way for the Government to collect some of the large sums of money which remained in the country as a result of the development of this modern industry. Many profited; cane growers, jute and cotton mill-owners, railways, machinery and other suppliers, fuel merchants, wholesalers and retailers in the sugar trade, but for the Government the easiest way to collect was at the source. This was undoubtedly unjust to the many people who had invested money in this industry on the promise of good returns for several years from a protected industry. Even before any reserves could have been set aside or plant properly depreciated, the excise duty absorbed all of the profits of the smaller factories. And, the average size of the Indian factories *was* small, very much smaller than the factories erected in the Philippines where the industry turned in a few years from small muscovido plants (gur plants) to the manufacture of cargo sugar (96 Pol.) by large central factories. The question of the minimum size of an economic plant thus became important and after considerable discussion a 400-ton unit was decided for Mysore. And, when I came to Mysore to build this 400-ton plant, I saw the possibilities of rapid expansion necessary for ultimate financial success. The yard and mill site were therefore planned from the start for 1,200 tons and the first extension to 800 tons was ordered as soon as the 400-ton plant was in operation. Had this not been done, with the consequent annual increase in yield from about 5,000 tons of sugar to over 8,000 tons in the second year, the Company would not have made any profit at all for the second year, because the excise duty paid during the second year was exactly the amount of nett profits made during the first year. Other owners also soon realised that the 400-tons unit was no longer economical, if a Rs. 40 excise duty had to be paid, with the result that factories with the necessary finance rapidly increased their daily crushing capacity.

Various critics have pointed out that both cane production and sugar content of the cane are much higher in Java, the Hawaian Islands and Mauritius, than in India. Such comparisons are not fair because of climatic variations, soil differences, irrigation facilities and also because of the methods of cultivation which are much better, being closely controlled by the factories who cultivate their own cane. Canes in these countries are cut as near as possible to maturity and are milled inside 24 hours after being cut and properly topped. With such raw material, it is easy to get 2% more sugar of higher purity than under the conditions prevailing in India, where cane is purchased from ryots who have neither the knowledge nor facilities or desire for intensive cultivation. Canes are cut days ahead, then transported to the mills over long distances; after arrival at the weighbridges, there is, sometimes, still further delay.

* A lecture delivered under the auspices of the South Indian Science Association, Bangalore, on the 16th December 1938.

Cane is a perishable product and no time should be lost in milling the cane as soon as possible, after it has been cut.

Now, with the cheap and very reliable motor lorries available, transport by motor lorries is quite a paying proposition.

In Mysore, the Sugar Company, assisted by the Government, embarked on a programme of building feeder roads from villages to existing main roads and improving main roads. Weighbridges located at strategic points, have reduced the maximum ox-cart haulage to seven miles.

From these yards, motor lorries and lorries with trailers move the cane in the shortest possible time to the Factory.

The ryot in India is paid by weight for his cane and, therefore, collects everything growing in his field including secondary and tertiary growths, badly grown cane, damaged stalks, diseased canes, and as much top as he thinks he can get away with. It is a battle of wits, the buyer making deductions for poor cane, the ryot trying to deliver the last scrap of cane from his field.

In Mysore State, conditions are very much better, because the ryots get instructions in the cultivation and husbandry of cane, have irrigation, are advanced fertilisers and agricultural implements, whilst the crop is controlled by Inspectors in the field who give only permission to cut down when the cane is as near as possible at its best.

Cane production in India varies from 10 tons to 62 tons per acre and whilst well-cultivated canes have a sugar content of 18% or even higher, we are glad if the average percentage of the cane milled reaches 14% whilst it is sometimes below 10%.

Furthermore, cane is bought in India as early as possible and as late as possible, as long as the recovery still allows a margin of profit.

In Java, the capacity of a factory is adjusted to the area on which the factory grows its cane and if at all it is possible, all the cane is milled inside 100 days and as near to maturity as possible. Bad canes, if there be any such, are left in the fields, canes are topped way down (tops are used for seed) and the cane milled as soon as possible after cutting. With similar raw material, the factory results in India would be as good, if not better, than in Java. Specially because the Indian factories being newer, are modern, which cannot be said of all Java factories, where fixed mills, old fashioned heaters and evaporators, double subsiding and primitive handling of mud, can still be found in several factories.

Conditions in the Philippines are also strictly not comparable with those in India. The erection of the large central factories in the Philippines was mostly undertaken by concerns already owning large sugar properties elsewhere. The size of the factories was large and they were built and operated by experts. Also the Filipino planter is a man of substance, cultivating hundreds of acres instead of one, with modern cultivation implements and as much fertiliser as he can economically use. Moreover, he is not paid in cash, but receives his share of the sugar actually obtained from his cane, so that he is very much interested in supplying the best cane he can.

A planter who brings bad cane to the mill would soon be unpopular with the other planters.

In the Hawaiian Islands, the care given in order to obtain good canes is perhaps even more than in Java and one could say that here the recovery of sugar starts in the fields, whilst in India, in many factories, the recovery starts at the weighbridge, by making deductions in weight or price. Improvement is only possible by educating the ryots to produce more cane per acre and better cane, but it will be a slow process.

Criticism has also been launched against the type of machinery installed, but we must not lose sight of the fact that cheapness was one of the principal conditions laid down by the new factory owners. As competition was so keen, and everybody copied specifications, there was soon a similarity between the equipment offered by British manufacturers.

Generally speaking, the equipment of the Indian sugar factories is as good as that of similar factories in the world, but it cannot be denied that the operation of the installations was, in the beginning, not very good and still leaves much to be desired. It is easier to build factories than to find experienced operators and the training of staff and labour requires time and patience.

My experience has been that the blame put on defective equipment is in most cases due to lack of operating experience.

In the Mandya Factory, the gradual increase in capacity has in no small measure been due to the experience gradually gained by staff and labourers. India produces many young men who have received an excellent college education and who after several years training have proved to be efficient operators. It has been my experience that it takes 5-6 years to train an unexperienced staff and the labourers to operate the complicated process of white sugar manufacture.

There is another reason why conditions in India are so different from those in the P.I. All factories here make plantation white sugar which requires considerably more skill than the making of cargo sugar of 96 polarisation. Not only is the machinery more complicated, but it needs more frequent cleaning and heavier operating charges through the larger amount of chemicals, some of corrosive nature, employed in the white sugar process.

We have in India sulphitation and carbonatation factories. Equally good sugar can be made by both processes, but as the crux of making good plantation white sugar lies in a perfect clarification of the mill juices, it is easier to obtain good sugars with the carbonatation process where all juice is filtered, than by subsiding, as is usual in sulphitation plants.

Sulphitation of the syrup, from which white sugar is boiled, to a pH of 5 or below, is necessary in both processes to obtain good plantation white sugar with reasonable keeping quality. If the pH rises above 5, good sugar cannot be made. The essential thing to obtain good clarification in a double sulphitation factory is the use of good lime.

The extraction obtained by the mill is of course important when the raw material is purchased for cash. Several factories have obtained an extraction of 93 per cent. In my opinion, this should not be higher in a factory making white sugar, as otherwise, too many impurities are introduced in the mill juice. In order to maintain good extraction, care should be given to the condition of the rollers, returner bars and scrapers and rollers which have worn smooth should be immediately regrooved. This means that spare rollers and a roller lathe must be part of the factory equipment, as well as an adequate supply of returner bars, scraper toes, etc. In many small mills this is lacking, with the result that the extraction suffers, as a result of poor operation, and not as a result of low quality of the original equipment.

Boiling house recoveries in good factories fluctuate in India between 83 and 87, which, considering the large quantity of molasses produced by Indian canes, cannot be considered unsatisfactory. As I said before, recovery should be started in the field; with mature sound canes, higher boiling house recoveries will follow.

The cost of manufacture, that is the amount spent per ton of sugar manufactured, for payrolls, chemicals, maintenance of machinery, general machinery supplies, filter cloth, lubricants, fuel or outside electric power, water rate, bags and twine and camp maintenance, is closely connected with the daily output. By making double the amount of sugar, costs will be nearly halved. For this reason anything which interferes with the output, stoppages for lack of cane, breakages, or lack of operating experience are exceedingly costly. The larger the output, the smaller will be the fixed charges per ton of sugar for off-season expenses, interest and Head Office expenses. This again brings us to realise that in order to be successful, a factory must have ample funds, so that the operation will not be interrupted for lack of spare parts.

A sugar factory cannot be run successfully on shoestring finance, and in well-managed concerns, the largest part of the profits is usually reserved for depreciation, purchase of equipment and cash reserves for emergencies. A financially strong concern will also be able to buy better quality cheaper and obtain the largest possible discounts.

The major part of the cost of sugar is the amount paid for the raw material, *i.e.*, the cane. The price paid in India by the factories for the cane is in many cases too high.

The cost of cane should not be more than 50% of what the factory obtains from its sugar sales. Therefore, if sugar prices are Rs. 240 per ton, the factory will obtain about Rs. 200 and the ryot should be paid not more than Rs. 100 per ton of sugar or, with a 10% recovery, Rs. 10 per ton of sugarcane.

If prices go up, the factory can afford to pay a higher price for the cane, but during the last five years, many factories have paid 60% and more of their sugar revenue for their cane. Improvement can, as I said before, only be expected from improved cane cultivation, as below a certain minimum price, the planter would not be able to exist. Improvements in the recovery is having, in most factories, the most careful attention of the management. With better canes, the cost of manufacture could be further reduced. The education of the ryot is a task which Government should undertake by spending some of the excise money for this purpose.

To illustrate what can be done, we have the instance of the Mysore Sugar Company, which held a crop competition, awarding prizes for the best cultivated cane on one-acre plots, five-acre plots and larger holdings. Prizes of Rs. 100 and Rs. 500 were awarded. The result showed what could be done by an intelligent ryot. None of the competitors produced less than 42 tons per acre, one just over 62 on a one-acre plot, one averaged over 48 tons per acre on an 18-acre plot. The sugar contents were over 17, the purities of the juice over 88, in some cases, considerably over these figures. Apart from the prizes, the ryots were rewarded by the very much larger cash returns from the tonnage harvested. The Mysore Sugar Company also operates several farms, mainly with the object to show the ryots, what results can be obtained when proper attention is given to the selection of cane and its cultivation. Manurial experiments are being made every year, not only with artificial manure, but with molasses, molasses lime powder and compost made from all refuse collected at the weighbridges.

Before closing, I should like to say a few words on the use of the by-products of the sugar factory, which has been given quite a bit of attention in India. The one and only profitable way to use the waste molasses is by converting it into alcohol. The best way to do this is by having a distillery attached to the factory so that any surplus bagasse can be used to operate the distillery. In Mysore, the distillery was erected in the second year of the factory's operation and has proved to be a very good investment. Rectified spirit (96°) is mainly manufactured, besides a small quantity of potable spirits for local consumption. All tractors, locomotives, service automobiles and lorries of the Company are operated on denatured rectified spirit or on a mixture of 2 parts spirit and 1 part petrol.

The Indian chemical industries can absorb large quantities of alcohol. Alcohol is the base of many modern explosives and the manufacture of acetone is being considered in Southern India. Rectified spirit of 96°, although making a good motor fuel in high percentage alcohol mixtures, cannot be used in petrol motors without making slight changes. The fuel is, therefore, not interchangeable with petrol. Moreover, the amount of petrol consumed in

India is so large that there would never be enough alcohol to permit the admixture of a large alcohol percentage.

In order to make the mixing of alcohol with petrol commercially possible, the rectified spirit must be dehydrated. Committees have been appointed to study the possibilities of the manufacture of dehydrated rectified spirit or absolute alcohol and the required legislation for the exclusive use of petrol alcohol motor fuel. Mysore State has taken the lead and has now an absolute alcohol plant in operation, and legislation is expected to be passed early next year making the mixing of all petrol sold in the State with a certain percentage of absolute alcohol obligatory.

The maximum percentage is 25%, but when all molasses manufactured in Mysore State is distilled into Absolute Alcohol, not more than 10% of the petrol consumption will be available. Even a 20% mixture will not require any adjustments to pertol motors. In fact the alcohol-petrol mixture will be a fuel of higher octane, slower burning, therefore less liable to "pinking", give less carbon deposit and less carbon monoxide in the exhaust gases. Even when using 96° pure alcohol, there is no difficulty in India in starting from cold, so that the petrol-alcohol mixture will provide a better fuel than the low grade petrol now sold in South India. If all waste molasses produced in India could be made into absolute alcohol, it would mean a large revenue to the sugar industry and an invaluable asset in case of war.

Other by-products of the factory are the surplus bagasse, but this is seldom available when "noble" canes are being cultivated. The best use of surplus bagasse is as fuel to run a distillery. Paper and Celotex manufactures are major industries requiring a huge capital outlay. Then we have the filter press mud, from which a kind of inferior wax can be obtained, but the best use is, in my opinion, to spread it on the fields, in order to correct bad soil conditions. We have also, ashes, which are useful for soil correction or can be used to fill insanitary holes. The fine ash dust we give to the Malaria Control Board, to mix with Paris green. The mixture is blown over stagnant water pools in order to kill the mosquito larvæ.

In closing, I would like to state that the Indian Sugar Industry has grown from a very promising infant to a well-grown youth, whose behaviour might be criticised, but who gives promise to grow into a mature and useful member of the Indian industry and who fully deserves the support and encouragement of its father, the Government of India.

Indian Central Jute Committee Technological Research Laboratories

THE laboratories were officially opened on January 3rd, 1939 by His Excellency the Viceroy, in presence of His Excellency Lord Brabourne. The foundations were dug in early February 1938 and the building and equipment were ready for the staff to go into occupation in early September.

The laboratories are situated in Regent Park, just outside the Tollygunge municipal area, about five miles south of Calcutta. The central block contains on the ground floor the Manager's office, jute godown and machine store, and on the first floor, the Director's office, general office and sample-room. The tower portion contains the main staircase and, on the second floor, the main water-tank. In the east wing there are three large, air-conditioned rooms which contain the spinning machinery, comprising a jute softener, teaser card, warp and weft breaker cards, warp and weft finisher cards, drawing frames, roving frame and spinning frames, all being of the most modern type. The machines are provided with individual electric motors, the drives being by V-ropes except in the case of the softener. A vary-pitch V-rope drive is fitted to one of the spinning frames. The drawing frames and the roving frames are each divided into two sections, one for the finer yarns and one for the coarser yarns. Each spinning frame has twenty spindles, one being for the finer yarns and one for the coarser yarns.

The spinning machinery has been provided with the object of enabling spinning trials to be made on small samples of fibre under controlled conditions.

The immediate objects of the investigations which are in progress are, firstly, to make reports on samples of fibre resulting from breeding trials, manurial experiments and the like and on any other samples which are sent for appraisement such as samples taken from the various jute-growing areas in connection with the Committee's marketing investigations. Minor modifications are being made in the spinning machinery in order that reliable information may be obtained from quite small samples (say 20 to 160 lb.) and special precautions are taken to ensure that the yarn produced accurately represents the sample of fibre under test.

The second main object of the early work in the laboratories is to find out what connections there may be between the various measurable characters, whether physical or chemical, of the raw fibre, its behaviour in spinning and the quality of the yarn produced. When this object is achieved it will be possible, by examining a representative sample of fibre, to predict its spinning quality and so to assess accurately its value. It may ultimately be possible to devise simple tests suitable for use in markets and baling houses.

The air-conditioning plant, which has been installed so that all tests may be made under standard conditions of temperature and humidity (80° F. and 75 per cent. Relative Humidity), is housed in the west wing of the buildings. This wing contains also the boiler, transformer and the tube-well pump. An open space has been left between the central block and the west wing in order to allow the south breeze to reach the range of the laboratories (chemical, physical and testing) situated along the north side.

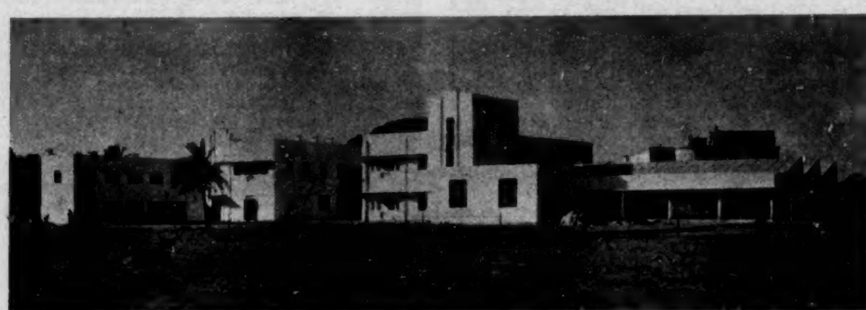
The chemistry laboratories are well equipped for carrying out the analysis of fibre samples in order to find out the proportions of the more important constituents (cellulose, lignin, pectin, etc.) and for the determination of other characters which may be expected to show a correlation with spinning quality. Town's gas is not available and a petrol-air gas plant has, therefore, been installed to supply the laboratories. A considerable portion of the apparatus is electrically heated.

The main work of the physical laboratories is to devise and perfect methods of measuring the properties, such as strength, fineness and flexibility, which are likely to be connected with the spinning quality of fibre.

Two testing laboratories have been provided and in both the standard conditions of temperature and humidity are maintained. In the smaller room there are instruments for measuring the tensile strength of yarn. The larger testing laboratory contains instruments for measuring the strength, fineness and flexibility of fibre and further instruments for the testing of yarns, including a "ballistic" yarn tester.

In all the tests statistical methods are in use for assessing the reliability of the results. In single thread tensile strength tests on yarns, for example, it has been found necessary to take the mean of at least three hundred tests. This gives a twenty-to-one chance that a difference of six ounces between the tensile strength of two yarns with a strength of about 10 lb. is a real difference. Similarly, in measuring the twist (turns per inch) of a yarn, the mean of one hundred tests is taken.

In the larger testing laboratory there is an electrically heated "moisture oven" of the latest type for determining the moisture content of samples. The checking of the moisture content of fibre is important for at least two reasons. If the moisture content is unduly high, the fibre is liable to deteriorate in storage, owing to bacterial action and further, a high moisture content means that water is being bought and sold instead of fibre. On the first floor, over the testing laboratories, there is a roomy library. A representative range of scientific and technical journals is being taken in regularly and back numbers of several important journals have been obtained. The nucleus of what is hoped will develop into a valuable collection of text-books bearing directly or indirectly on the jute industry, has been collected. A classification suitable for a specialist library relating to jute has been worked out and the indexing of articles and information relating to jute has been commenced.



In a separate building to the south of the main block, workshops have been erected in which work required in connection with the spinning laboratories may be done and instruments and apparatus required by the chemist and physicist may be constructed. On a terrace over the chemistry and physics laboratories, there is a space where further laboratories may be built to meet future requirements. Room for extensions is also available to the east of the spinning rooms and in the south portion of the compound.

CENTENARIES

By S. R. Ranganathan, M.A., L.T., F.L.A.
(University Librarian, Madras)

Bussiere, Paul (*d.* 1739)

PAUL BUSSIERE, a French Anatomist, fled his country on account of his being a Protestant. He was naturalised in England, where he soon attained high reputation. He attended on Queen Caroline. According to Lord Harvey, the King and Queen had a great opinion of him and preferred him to every other man of his profession.

His Contributions

Bussiere was one of the first to introduce a course of lectures on anatomy into England. He was a Member of the Royal Society and contributed six papers to its *Philosophical transactions.* He also published two books: (1) *Lettre a M. Bourdelin pour servir de reponse an sieur Mary sur L'usage due trou oval dans la fœtus* (1700) and (2) *Nouvelle description anatonique du cocur des tortues terrestres de l'Amerique et de ses Vaaisseaux* (1713). He also contributed frequently to the *Memoires* of the Academy of Sciences of his native land.

Bussiere died at London, January 1739.

Gabb, William More (1839–1878)

WILLIAM MORE GABB, an eminent American Palæontologist, was born in Philadelphia, January 20, 1839. His parents kept a millinery shop. He graduated in Classics in 1857. But his interests were in minerals and fossils. Hence he spent the next three years in studying under James Hall, the foremost among the then palæontologists of America. He formed useful contacts with many experts by frequent visits to the Academy of Natural Sciences and the Smithsonian Institution.

His Career

In 1861 he was appointed palæontologist on the Geological Survey of California. In 1867 he went to survey the Lower California. From the next year he surveyed Santo Domingo for about three years. In 1873 he did similar work in Costa Rica, where exposure to costal fever damaged his lungs.

His Contributions

Even in his twenty-second year, Gabb was considered to be the best authority on cretaceous marine palæontology. He contributed as many as 88 papers in his short span of thirty-nine years. Fifteen of these were on cretaceous fossils. The whole of the second volume and nearly a half of the first volume of the palæontological series of the Geological Survey of California were from his pen. V. 20 of Petermann's *Mittheilungen* contains his report on Lower California. The *Transactions* of the American Philosophical Society contains his memoir of 200 pages on the island of Santo Domingo. The geographical part of his work on Costa Rica appeared in 1875 as a Government publication; but before the palæontological work could be published, Gabb died of consumption, May 30, 1878.

Vernon-Harcourt, Leveson Francis (1839–1907)

LEVESON FRANCIS VERNON-HARCOURT, a British Engineer, was born in London January 25, 1839. His grandfather was Archbishop of York. Having had his earlier education at Harrow and Oxford, he learned engineering under Sir John Hawkshaw from 1862 to 1865. From 1866 to 1870 he was resident engineer at the East and West India Docks. After seeing service under several harbour authorities, he settled down in London in 1878 for consulting practice. From 1882 to 1905 he occupied the Chair of Civil Engineering in the University College, London.

His Contributions

As consulting engineer, he acted for a number of public bodies—chiefly harbour authorities, canal and other navigational authorities. He was the author of eighteen papers, published in the *Proceedings* of the Institution of Civil Engineers. He also contributed several others to the Royal Society, the British Association and the Navigation Congress. His chief books are *Rivers and canals* 2 V. (1882), *Harbours and docks* (1885), *Civil engineering* (1902) and *Sanitary engineering* (1907).

His Visit to India

In 1896 he came to India at the request of the Calcutta Port Authorities to inspect and report on the navigation of the Hooghly. His report appeared in the *Proceedings* of the Institute of Civil Engineers, in 1905. In 1906 he was a member of the International Consultative Commission for the Suez Canal works.

His Honours

His reputation stood high in Europe. He was appointed as a member of the Jury for the Paris Exhibition of 1900 and the St. Louis Exhibition of 1904. Next year he was President of the Mechanical Science Section of the British Association. For his services on an international jury in Vienna in connection with schemes for large canal lifts, he was made a Commander of the Imperial Franz-Joseph Order of Austria-Hungary. His essey *On the means for improving harbours established on low and sandy coasts like those of Belgium* was placed second. He was also awarded a Telford medal, a George Stephenson medal, Telford premiums and a Manby premium. He bequeathed a 1000 *l* to the Institution of Civil Engineers to provide biennial lectures on his subject.

After a few weeks' illness Vernon-Harcourt died at Swange, September 14, 1907.

ASTRONOMICAL NOTES

Planets during February 1939.—Mercury will be visible as a morning star for a few days in the beginning of the month; on February 19, it is in superior conjunction with the Sun and will afterwards become an evening star. Venus is gradually moving towards the Sun, but will still continue to be a bright object in the eastern sky visible for some time before sunrise. Mars also can be seen about the same time near the meridian in the constellation Scorpio; and when it is near the first magnitude star Antares (α Scorpii) which is approximately of the same brightness and reddish colour, the two objects will present an interesting appearance in the morning sky.

Jupiter being too near the Sun, is not favourably situated for observation. Saturn is slowly moving eastward along the southern border of the constellation Pisces, and will be visible towards the west for about three hours after sunset. The rings continue to widen and the angular dimensions of the axes of the ellipse are $37''\cdot 5$ and $6''\cdot 4$ respectively. Uranus is in the constellation Aries and will be an hour west of meridian at sunset. The following close conjunctions of the Moon with planets may be noted:—February 12, Mars; February 15, Venus; and February 25, Uranus. Lunar occultations of some interest that can be observed in these latitudes are—α Virginis (Spica), magnitude 1·2 on February 8 and β' Scorpii, magnitude 2·9 on February 11.

T. P. B.

SCIENCE NOTES AND NEWS

New Year Honours.—The New Year Honour list contains the following names of scientists:

Knighthood: Major H. G. Howard, Chief Engineer for Electricity, Madras; Col. A. J. H. Russell, I.M.S., Public Health Commissioner, Government of India.

C. I. E.: Dr. W. Burns, I.A.S., Agricultural Expert to the Government of India, Imperial Council of Agricultural Research Department; Mr. H. B. Dunnicliff, Chief Chemist, Central Revenues Chemical Service and Principal, Government College, Lahore; Lieut-Col. G. Covell, I.M.S., Director, Malaria Survey of India.

Rao Bahadur: Mr. V. Ramanatha Iyer, Cotton Specialist, Coimbatore.

Rao Sahib: Mr. M. G. Pathale, Research Assistant in Botany, Agricultural College, Cawnpore; Mr. Surjakanta Mitra, Assistant Professor of Physics, Science College, Patna.

O. B. E.: Major D. P. Bhargava, Professor of Surgery, Prince of Wales Medical College, Patna.

M. B. E.: Mr. D. C. Chakravarti, Professor of Clinical and Operative Surgery, Medical College, Calcutta.

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The Intensity of Solar Radiation.—The hourly and seasonal variations in the solar radiation at Poona, have been recorded in a recent publication of the Indian Meteorological Department (P. K. Raman, *Memoirs of the Indian Meteorological Department*, 1938, 26, Part VIII). The intensity of radiation coming from the sun and from the sunlit sky is a factor of fundamental importance in meteorology and in the study of bioclimatic phenomena. Long records of radiation measurements are confined to a few stations in Europe and North America. In India, work on this subject was started in 1934 at Poona, and the *Memoir* recently issued incorporates the data obtained for all the days for which the data were available in 1935.

The Moll solarigraph was employed for the measurement of the total radiation. The maximum amount of radiation recorded during the year was 855 gm. calories (May 4) and the minimum, 116 gm. calories (July 20). During the summer months, April and May, the mean daily radiation recorded was 784 and 775 gm. calories per day respectively. During the monsoon months, the energy is small, *e.g.*, 388 gm. calories per day in July. The value changes to 600 in November, 478 in December and it steadily increases to the summer maximum.

The maximum radiation epoch occurs at noon during all the months. This epoch is not pronounced during the monsoon months.

It has been observed that a covering of the cirrus clouds does not affect, materially, the total radiation recorded on a horizontal surface. A sheet of cirro-stratus clouds decreases the total radiation by about 10 per cent., while a thick cirro-stratus diminishes the intensity by 20 per cent. Medium clouds cut off more of the incoming radiation.

* * *

Mineral Production in India.—Among the chief sources of production of manganese in the world, India occupies the second place with 1,051,594 tons valued at £3,229,554 in 1937. Russia has the pride of place. The United Kingdom is the chief importer of Indian manganese ore. The industry has shown a gratifying recovery, and its output this year reached the peak point of 1927 (1,129,353 tons valued at £2,703,068). In 1933, the production had diminished to one-fifth of that of the peak year 1927, but its value was only one-twenty-second part of the value of the 1927 production.

The fall in the price of the manganese ore from 1924–32, is to be correlated with the fact that during the period 1924–27, the rate of increase in the production of manganese ore was much greater than that in the world's production of pig iron and steel. There was

a disastrous decline in the activity of the iron and steel industry during the years 1931–32. The world's available supplies of manganese ore are much in excess of normal requirements. Russia is able to place large quantities of ore on the market, at a price which many Indian producers are unable to compete.

There is now a steady consumption of manganese ore at the works of the two principal iron and steel companies, not only for use in the steel furnaces of the Tata Iron & Steel Co., and for the manufacture of ferro-manganese, but also for addition to the blast furnace charge in the manufacture of pig iron. The consumption of ore by the Indian Iron and Steel Industry in 1937 was 60,219 tons.

Regarding the production of iron ore, India is the second largest country in the British Empire. The output, 2,896,258 tons valued at £352,487, however, is completely dwarfed by the production of the United States (48,750,000 tons in 1936) and France (32,300,000 in 1936), but her reserves are not much less than ¾ of the estimated total of the United States and there is every hope, that India will eventually take a more prominent place among the world's producers of iron ore.

The Tata Iron & Steel Co. produced 885,393 tons of pig iron, 665,309 tons of steel and 8,041 tons of ferro-manganese in 1937. The corresponding figures for the previous year were respectively, 858,272, 660,291 and 3,263. The total production of pig iron in India was 1,621,260 tons in 1937. Japan continued to be the principal importer of Indian pig iron.

The production of petroleum in India reached, in 1937, the highest figure in the history of the industry (350,322,222 gallons). At the end of 1937, there were 2,910 wells producing in the field. India, however, contributed only 0·50 per cent. to the world's production of petroleum during the year, and of this 0·40 per cent. came from Burma, and only 0·10 per cent. from India proper. The contributions from some other important petroleum producing centres were: U.S.A. 62·7 per cent., Russia 9·9 per cent., Venezeula 9·2 per cent., Iran 3·8 per cent., Netherland Indies 2·6 per cent., and Rumania 2·5 per cent. The production methods employed throughout the field are characterised by a realization of the importance of the conservation of oil and gas and the prevention of waste, whether surface or underground. During the year, the Burma Oil Company's deep test well at Monatkon was abandoned at 8,319 feet, as no productive sand had been encountered.

* * *

Report of the Coal Mining Committee.—The discussion on the Report arranged under the auspices of the Geological, Mining and Metallurgical Society of India, has now been issued in the form of a bulletin (No. 2, June 1938). The criticisms on the report, range in detail over practically every relevant point, investigated by the Coal Mining Committee, the chief among them being stowing and conservation of coal. The critics are unanimous on the following issues:—Stowing should not be insisted upon in every case, but had better be confined to specific mines, where fires are frequent. The cess proposed in stowing is too large and should, in the first instance, be anna one or so, to be enhanced later, when the actual cost has been studied. The Indian Railways are the worst delinquents in the utilisation of coal and should be directed to use inferior grade. A Research Station to investigate into the possible methods of conserving coal, and of safe and economic methods of mining it, as contemplated by the Committee, is a salutary proposal, but at the first instance, it is preferable to start such researches in the existing institutions as the Indian Universities, the Indian School of Mines and the Geological Survey of India. The dissenting minute by Drs. Nag and Krishnan advocating the nationalization of coal mining, is the only cure for the present ill-management, unsafe mining and unhealthy competition obtaining in the collieries. The appointment of an appellate authority is welcome, but its personnel, salaries of staff and other details should be on more economic and useful basis. The Railways should treat coal freight on exactly the same preferential basis as is current in South Africa.

Other members who took part in the discussion—Messrs. N. N. Chatterji, S. C. Ghosh, M. M. Mukherji and J. S. Bhaduri, Professors S. K. Roy and C. Forrester, and Dr. S. K. Sarkar—have offered suggestions on various technical points such as the desirability of studying the hydrogenation of coal, the utilization of the by-products, the electrification of a part of the railway, the use of brick and dust coal in the railway engines, the method of stowing to be employed, the desirability of grading coal, the method of improving on Dr. Fox's estimate of the coal reserves, and the participation in and allocation of a group of the officers of the Geological Survey of India for exclusively engaging themselves in such economic investigations of national importance.

* * *

The Friction of Shoe Brakes applied to a vehicle in motion, is a very important factor in finding out the stopping distance of the Vehicle. This problem with respect to Railway shoes brakes was investigated from 1880 to 1930, and a large amount of experimental work was done to determine the coefficient of friction of Railway brake shoes under varying conditions of speed and brake shoe pressures. The experiments were limited to maximum speed of 65 miles per hour and pressures of 15,000 lbs. With the general increase in speed of all trains at the present day, the existing data had to be supplemented by further data to bring them up to date. The Engineering Experimental Station of the University of Illinois, in the Department of Railway Engineering, undertook this as part of their work, and the results have been published in their Bulletin 301, entitled "The Friction of Railway Brake Shoes at High Speed and High Pressure" by Herman J. Schrader, 1938. "The main purpose of the tests was to determine the coefficient of friction of brake shoes, the stopping distance, and the brake shoe wear under conditions which

simulate those that prevail on the road in stopping trains that travel at high speeds."

The investigations were conducted on brake shoe pressures, varying from 4,500 lbs. to 20,000 lbs. and under each of these pressures, stops were made from initial speeds of 60, 80 and 100 miles per hour. Two different patterns of shoes, one light and the other heavy, were tested, and in each pattern there were chilled-end shoes and also those with plain ends, ground to shape. The wheel tested was the "multiple wear" rolled steel wheel of the American Railway Association standard design, 33 inches diameter, for use on 6-inch and 11-inch axles, chosen by a representative of the University from the wheel stock of a Western Railroad Company. The wheel weighed 773 pounds and was 8·66 feet in circumference. All the tests were made on the brake shoe testing machine of the University, consisting essentially of a car wheel keyed to a main shaft which carries also a heavy flywheel, the system being rotated at any desired speed by means of a steam engine, which drives the shaft through a pulley and clutch. The shoe to be tested is held in a brake shoe head and is suspended above the wheel from one of a system of levers, by means of which the shoe may be applied to the wheel at any desired pressure up to 20,000 lbs.

The tests conclusively proved that, with the particular types of shoes and kind of wheel tested, no cast iron brake shoe should be subjected to braking condition which will require it to perform and dissipate more than 90,000 ft. lbs. of work per sec. Also, if the building up of the brake shoe material on the wheel tread is to be avoided, the workrate performance of the shoe should be kept below 70,000 ft. pounds per sec. Another important conclusion was that pressures of 20,000 lbs. combined with high speeds, cracked the wheel tread at a very rapid rate, and in order to avoid this type of failure, the rate of performing work on the wheel should be kept below 125,000 ft. pounds per sec. The heavy pattern shoes are more economical than the lighter pattern; but the chilled-end shoes were not superior to plain-end shoes when tested at high speeds and high pressures. K. B. K. R.

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Molecular Distillation.—In a series of four important papers read before a joint meeting of the Chemical Engineering Group and the London Section of the Society of Chemical Industry, various aspects of the subject of Molecular Distillation and its technical applications were discussed. The first practical application of molecular distillation began nine years ago, but on account of the necessity for employing extremely low pressures of the order of 10^{-6} atmospheres, the technique could not be developed till improvements and developments were made on Langmuir's original condensation pump, which enabled high vacua of this order being obtained on a technical scale.

On account of the extremely low pressures employed in molecular distillation, the rate of distillation depends on the saturation pressures of the distillant. An apparatus consisting of a shallow pool of heated liquid with a condensing surface of a few centimetres above it is used, the whole being enclosed in a chamber which can be evacuated to a pressure of 10^{-6} atmospheres or less. It is very important to remove traces of uncondensable gases dissolved in the liquid or produced by slight decomposition and various special methods have been developed to effect this.

The most recent and perhaps the most important application of Molecular Distillation is the isolation of Vitamin A directly from the fish-liver oils. Before this, Vitamin A concentrates were prepared from the unsaponifiable portion of the oil. Messrs. British Drug Houses, Metropolitan Vickers and Imperial Chemical Industries in England and the Eastman Kodak Co. in America, have been associated with these developments. The work done on the Molecular Distillation of fish-liver oils has shown that Vitamin A occurs in these oils in the form of esters and Tischer isolated it in the form of a palmitate. Crystalline Vitamin A, melting at a temperature of 7° to 8° has also been prepared, by Molecular Distillation and is expected to have a potency of about three million international units per gram. Further work on this subject is being pursued actively and more interesting developments are awaited.

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Salmon of the River Shannon, Ireland.—Arthur E. J. Went of the Department of Agriculture, Fisheries Branch, Dublin, has in his paper on "Salmon of the River Shannon" (*Proc. Roy. Irish Acad.*, Vol. XLIV, Section B, No. 11, pp. 261 to 322) given a very instructive account of the analysis of the salmon stock of the year 1927 and the growth of salmon smolts in the River Shannon from an examination of vast material collected from the net fisheries at Lax Weir and Glin Co., Limerick and from the rod fisheries between O'Briens Bridge and Killaloe. In the body of the paper the author gives the results of examination of scales and extensive data and graphs indicating the periodical growth of smolts. The factors governing the smolt migration has also been discussed. In the 1927 stock 98 per cent. of the total catch formed one and two year smolts. April, May and June are stated to be the most important months from the point of view of the commercial catches. It has also been observed that there is a decrease in the percentage of females with the increase in the age of the fish. The spring fish appear to improve in condition with age better than the summer fish. The fastest growing smolts were the first to migrate. This paper by Arthur Went is indicative of the high class work that is being done in the Fisheries Department in Ireland.

* * *

Breeding Habits and Early Development in Hill-stream Fishes.—Mr. S. Jones of the Department of Agriculture and Fisheries, Travancore, has made an interesting contribution to our knowledge of the breeding habits and early development of two of the hill-stream Cyprinoid fishes—*Danio (Danio) malabaricus*

(Jerdon) and *Garra ceylonensis ceylonensis* (Bleeker)—(*Ceylon Journ. Sci.*, Sec. C, Fisheries, 1938, 6). The author after an extensive search for the eggs of these fishes in the mountain torrents of Ceylon was able to locate their breeding places. The eggs of *Danio* have been observed to be deposited among the algal growth in the shallow regions of the stream, whereas the eggs of *Garra* were found loose on the bottom of the fairly calm water in larger pools close to the bank beneath the algæ. A good account of the early development of both the forms has been given. The most interesting feature in the early devlopment of *Danio* is the presence of a large cement organ in the mid-dorsal region of the head. The secretion of this gland helps the larvæ to attach themselves to the algal filaments until the yolk is absorbed and the pectoral fins are developed. This is a very interesting case of adaptation to life in hill-streams. The presence of a cement organ during the development of a cyprinoid has been recorded for the first time.

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Cytoplasmic Inclusions in *Spirostomum*.—While our knowledge of the structure, distribution and function of the Golgi apparatus and other cytoplasmic inclusions in the Metazoa is fairly extensive, the findings in the Protozoa are very meagre and conflicting. Since the time Nassanow's theory that the contractile vacuole of the protozoan was homologous with the metazoan Golgi apparatus was refuted, many attempts have been made to determine its structure and position and K. M. R. Browne (*Journ. Roy. Micros. Soc.*, 1938, 48, Pt. 3) has studied it in *Spirostomum ambiguum*. Using almost all the classic methods, he has demonstrated the presence of the Golgi bodies as spherical structures, blackened by osmic acid but not revealed by silver techniques and scattered all over the cytoplasm. They appear to have an osmophile membrane surrounding an osmiophobic medulla. They apparently have no connection with the contractile vacuole whose wall in *Spirostomum* is not osmiophilic. The mitochondria are more numerous and are also scattered in the cytoplasm. They are in the form of deeply staining discoidal rods.

* * *

A New Teak Planting Technique.—In the past, teak plantations were formed either by direct sowing of the seeds or by transplanting small seedlings at the beginning of the rains, but with either of these methods, results were frequently irregular, and partial failure of the plantations was a common experience. The rate of growth of the young teak plants raised by these methods was moreover slow and the cost of keeping them from being swamped by the vigorous weed growth experienced in moist west-coast localities was correspondingly high.

More recently, experiments conducted in Madras by A. L. Griffith (*Indian Forest Records*, Sylviculture, 3, No. 2) have proved that far more regular results can be obtained by planting out stumps, prepared by digging up one-year-old nursery seedlings and cutting off the shoot at about one inch above and the root at about 8 or 9 inches below the original ground level and trimming off all side roots. These stumps are much more resistant to adverse weather conditions after planting, give higher survival percentage and grow faster than either direct sowings of seed or planted nursery seedlings.

Carefully planned experiments have shown that the best date for planting was mid-April or early May. The survivals may be as high as 99 per cent. The results were unexpected and surprising. The stumps very often experienced an almost complete drought for anything from ten days to three weeks after planting, while the soil was baked hard and dry. At first it seemed inconceivable that they could survive such early planting and much less, give improved results, and it took five years to prove definitely that early planting was not only feasible but reliable and very beneficial. It is emphasised, however, that these results have been obtained for localities with a west-coast climate and that, while some degree of early planting is probably beneficial in most teak planting areas, local experiments must be carried out to determine the earliest safe date in each case, otherwise expensive failure may be experienced. The experiments are now being extended to drier localities.

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Pasteur Institute of South India, Coonoor.—The Annual Report of the Director for the year ending 31st December 1937, records an extension of the activities of the Institute over those of the previous years. The Paris fixed virus was used exclusively in the preparation of the vaccine. It was in its 994th passage at the close of the year. Semple's 5 per cent. carbolised sheep brain suspension was the vaccine in use. 426 patients underwent treatment at Coonoor, and 15,371 courses of antirabic vaccine were issued to the subsidiary centres. The mortality rate for all treated cases (complete and incomplete) was 0·15 per cent. 31 new subsidiary treatment centres were opened during the year in the Madras Presidency.

Antirabic vaccine is also available for the prophylactic treatment of animals. During the year, 34,720 c.c. of 5 per cent. carbolised sheep-brain vaccine was issued for the treatment of animals, chiefly to veterinary officers in the Madras Presidency and neighbouring Indian States.

The Institute continued to receive clinical specimens from hospitals and medical practitioners in the Nilgiris District for bacteriological examination. 4,382 such specimens were examined during the year.

A special meeting of the members of the Association of the Pasteur Institute of South India was held at Coonoor, on 10th June 1937, when a resolution recommending that certain definite lines of research connected with rabies should be undertaken at the Institute under the direction of the Director of the Pasteur Institute, was adopted. The lines suggested were: Extension of the work which was already being done with the object of obtaining concentrated rabies

virus by cataphoresis method; investigation by culture methods, of the nature and identity of rabies virus; and any allied research bearing on the subject of rabies, such as the effect of administration of vitamin to infected animals.

Dr. Veeraraghavan, M.B.B.S., has been appointed Special Research Officer for a period of five years, with effect from 21st March 1938.

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Educational Broadcasts.—The Madras Station of the All-India Radio has issued a pamphlet giving the programme of educational broadcasts for the first quarter of 1939. The programmes are transmitted on the medium wave and are of half-hour duration: (1) 2 p.m. to 2–30 p.m., for the benefit of the pupils of the High School, and (2) 4 p.m. to 4–30 p.m. for children. The programme for the High School pupils includes "Things of Interest", (5 minutes) from the news of the world, and talks lasting for 15 minutes on topics of scientific and general interest. The programmes for children also include talks on subjects of general interest, physical and natural sciences, biography, history, geography, etc., the treatment being adapted to the psychology of the child, which is able to intelligently understand a subject, if it is presented in suitable form such as a story. The talks will be in two languages, Telugu and Tamil.

It is indeed very thoughtful on the part of the Station Director to have printed the programme in the form of a booklet and made it available to the different schools and members of the public. The Madras Station has been doing commendable work in harnessing the radio for educational work.

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Mining, Geological and Metallurgical Institute of India.—The following prize and medals for papers on mining and metallurgical subjects were announced at the meeting of the Institute held on January 13:—

(1) The Government of India Prize of Rs. 500 and the Institute Gold Medal were awarded to Mr. J. Thomas for his paper entitled "Methods of Stowing for Indian Mines"; (2) The Institute Silver Medal to Dr. Cyril S. Fox, for his paper entitled "Mineral Developments in Soviet Russia"; and (3) The Institute Bronze Medal to Mr. P. N. Mathur for his paper entitled "Small-scale Manufacture of Iron and Steel in India by the Direct Method".

* * *

Benares Hindu University.—His Exalted Highness the Nizam of Hyderabad has donated one lakh of rupees to the Benares Hindu University, towards the endowment of a Chair of Indian Culture, with a view to promoting Hindu-Muslim unity.

The Cochin Durbar have endowed a Chair to be called "Rama Varma Chair" and have been pleased to donate a sum of Rs. 9,000 as yearly recurring grant, to the University.

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University of Calcutta.—Dr. Girindrasekhar Bose, D.SC., who acted as the Head of the Department of Psychology, University of Calcutta, has been appointed University Professor of Psychology for a period of five years.

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University of Mysore.—Dec. 1938. *University Extension Lectures*: The following lectures were delivered under the scheme of Extension Lectures during the month:—(i) Mr. S. G. Vaze, "The Treatment of Minorities in Czechoslovakia", in English at Bangalore and on "Czech-German Settlement of Munich". (ii) Mr. V. N. Rangaswami, M.A., B.SC. (Tech.), A.M.C.T., A.M.I.E. (India), "Bituminous Materials and Their Uses", in English at Bangalore. (iii) The University Teachers' Association held its Lecture camp during the Christmas holidays in Shimoga from the 23rd to the 27th December 1938.

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Announcements

The annual meeting of the **British Association for the Advancement of Science** will be held this year at Dundee, from August 30 to September 6, under the Presidency of Sir Albert Seward, F.R.S.

Indian Science Congress.—The Twenty-seventh Session of the Congress will be held at Madras, from 2–8 January, 1940. Prof. Birbal Sahni, F.R.S., has been elected General President. The Sectional Presidents will be: Prof. K. S. Krishnan (*Mathematics and Physics*), Dr. S. Krishna (*Chemistry*), Prof. L. Rama Rao (*Geology*), Dr. S. P. Chatterji (*Geography and Geodesy*), Prof. Y. Bharadwaja (*Botany*), Prof. B. K. Das (*Zoology*), Rao Bahadur K. N. Dikshit (*Anthropology*), Mr. J. R. Haddow (*Medical and Veterinary Research*), Mr. E. McKenzie Taylor (*Agriculture*).

The Eighteenth International Congress of Agriculture, organised by the International Confederation of Agriculture (former International Commission of Agriculture), will be held in Dresden from June 6–12, 1939.

An Executive Committee has been formed under the presidency of Herr M. Behrens with Dr. F. Sohn as Secretary-General. This Committee has arranged for the circulation of bulletins, giving information in regard to the preparatory work of the Congress. Communications regarding the Congress should be addressed to the General Secretariat of the Congress, Berlin, S.W. 11, Hafenplatz 4.

Messrs. Edward Arnold & Co., have drawn our attention to an omission in the bibliographical details given in the review notice of the book, entitled "The Behaviour of Animals" (November 1938, 7, 249). The publishers have pointed out that the book is the *Second Edition*. We regret the ommission.

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We acknowledge with thanks, receipt of the following:—

"Agricultural Gazette of New South Wales," Vol. 39, No. 12.

"Monthly Bulletin of Agricultural Science and Practice," Vol. 29, No. 11.

"Agriculture and Live-Stock in India," Vol. 8, No. 6.

"The Philippine Agriculturist," Vol. 28, No. 7.

"Journal of the Royal Society of Arts," Vol. 86, Nos. 4488–91.

"L'Agricoltura Coloniale," Vol. 31, No. 10.

"Biochemical Journal," Vol. 32, Nos. 11 and 12.

"Journal of the Indian Botanical Society," Vol. 17, No. 5.

"Journal de Chemie Physique," Vol. 35, No. 10.

"Chemical Age," Vol. 39, Nos. 1013–16.

"Transactions of the Faraday Society," Vol. 34, No. 212.

"Indian Forester," Vol. 55, No. 1.

"Forschungen und Fortschritte, Vol. 14, Nos. 34–36.

"Bulletin of the American Meteorological Society," Vol. 19, No. 7.

"Calcutta Medical Journal," Vol. 34, No. 6; and Vol. 35, No. 1.

"Review of Applied Mycology," Vol. 17, No. 12.

"American Museum of Natural History, Vol. 32, No. 5.

"Bombay Natural History," Vol. 40, No. 3.

"Nature,' Vol. 142, Nos. 3604–07.

"Indian Journal of Physics," Vol. 12, No. 5.

"Journal of Research (National Bureau of Standards)", Vol. 20, Nos. 1–5.

"Ceylon Journal of Science," Vol. 6, Sec. C.

"Science Forum," Vol. 3, No. 2.

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Catalogues

"Monthly List of Books on Natural History and Science," December 1938. Messrs. Wheldon & Wesley, Ltd., London.

"Diffusion Pumps for the Production of High Vacua," W. Edward & Company, London.

List of Publications issued by the International Institute of Agriculture (October 1938).

ACADEMIES AND SOCIETIES

National Academy of Sciences, India:

December 17, 1938.—A. C. Bannerji and Mohd. Nizamuddin: *Jupiter Atmosphere.* B. P. Pande: *On the trematode genus* Lypersomum *Looss,* 1939, (Dicrocœllidæ) *with a description of two new species from India.* B. P. Pande: *Two new species of trematodes from* Anhinga malenogaster, *the Indian Darter or Snake-bird.* S. N. Banerji and S. Ghosh: *Changes in the viscosity of agar sol with concentration.* Jagraj Behari Lal: *Constitution of Santalin.* R. R. Bajpai and B. D. Pant: *Further studies of the F-region at Allahabad.* A. B. Sen: *Migration of para-halogen atom in a derivative of* meta-cresol.

Indian Chemical Society:

October 1938.—Jamiat V. Lakhani and Rustom P. Daroga: *The Determination of the Parachors of Inorganic Salts in Solutions and their Structure—Part II. Some Lithium, Sodium, Rubidium Salts and Atomic Parachors of the above Elements including Cæsium.* K. Ganapati: *The Chemotherapy of Bacterial Infections—Part I. Synthesis of Some Derivatives of Sulphanilamide.* Mahadeo Prasad Gupta and Sikhibhushan Dutt: *Chemical Examination of the Seeds of* Cleome viscosa, *Linn.—Part I. The Constituents.* Dines Chandra Sen: *Studies in the Camphor Series. Part V—Some Derivatives of* iso-*Nitrosocamphor.* N. R. Dhar and S. K. Mukerji: *New Aspects of Nitrogen Fixation and Conservation in the Soil.* N. C. Sen Gupta: *On the Physico-Chemical Properties of Indian Bentonites—Part I.* B. N. Ghosh and D. K. Chowdhury: *Enzymes in Snake Venom.*

Meteorological Office Colloquium, Poona:

December 1938.—C. W. B. Normand: *On Soaring and Gliding Flight.* S. K. Banerji: *Relationship between upper wind velocity and temperature.* A. K. Roy: *On forecasting of weather in South Bengal during the Nor' wester season mid-March to mid-May.* M. W. Chiplonkar: *On brightness of the Zenith sky at twilight and its relation to upper air temperatures.*

The Indian Botanical Society:

December 1938.—L. M. Ghosh, S. Ghosh, N. R. Chatterjee and A. T. Dutt: Actinomyces: *Their Biochemical reactions as aids in their classification—Part I. Reduction of Nitrates.* A. B. Saran: *A short note on the rate of respiration and respiratory quotient of starved leaves of* Aralia *sp. before and after a course in nitrogen.* M. J. Thirumalachar: *On the morphology, cytology and parasitism of* Uromyces Hobsoni *Vize* (U. Cunninghamianus *Barc*), *A preliminary note.* M. S. Murdia: *Cytological studies of certain members of the family* Saprolegniaceæ—*Part I.* L. P. Khanna: *On two species of* Anthoceros *from China.* K. R. Ramanathan: *On a form of* Anabænopsis *from Madras.* C. Bhashyakarla Rao: *The* Zygnemoideæ *of the Central Provinces, India—I.* V. B. Shukla: *On a new species of* Dadoxylon, D. Deccani, *sp. nov., from the Deccan Intertrappean Series.* R. N. Singh: *The* Zygnemoideæ *of the United Provinces, India—II.*

The Entomological Society of India:

November 9, 1938.— H. R. Bhalla: On Sylepta derogata *Fab., the Cotton Leaf Roller.*—The author describes in detail its bionomics and control. For successful control the following measures were recommended: (1) eradication of ratoon cotton and other alternative host plants such as *Hibiscus esculentus; Althea rosea; Abutilon indicum; Malvestrum tricuspidatum; Urina lobata and Malva parviflora,* (2) Hand picking, (3) dusting the infested crop with sodium fluosilicate or Paris green, in the ratio of 1 : 8, (4) destruction of the shed material, and (5) ploughing the infested fields with furrow turning plough during January and February in order to bury the hibernating caterpillars.